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ABSTRACT

The current situation of doctoral research staff in academe is described and the probable trends affecting them are examined. This group is comprised of university-employed Ph.D. scientists and engineers who are considered neither postdoctoral appointees (temporary trainees) nor members of the faculty and who are principally involved in research activities. In 1977, the group included an estimated 4,200 individuals and represented 3 percent of the total number of Ph.D. scientists and engineers employed in the academic sectors. More than half of the doctoral research staff were employed in the biosciences or physics. Between 1975 and 1977, the numbers holding research staff positions increased 20 percent, compared with an 8 percent growth in faculty. The doctoral research staff group, while still small in total number, is disproportionately important for research. In many universities, members of the group are treated as second class citizens with respect to privileges and conditions of employment. A detailed statistical analysis of the demographic characteristics and employment situations of doctoral research staff is presented. Appended materials include a list of institutions visited and examples of the questions asked during site visits; the agenda and participants in the Conference on the Changing Role of Doctoral Research Staff in the University; sampling error estimates for survey data; and characteristics and employment of selected groups of Ph.D. scientists and engineers. (SC)

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NONFACULTY DOCTORAL RESEARCH STAFF IN SCIENCE AND ENGINEERING IN UNITED STATES UNIVERSITIES

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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A Report of the

COMMITTEE ON A STUDY OF POSTDOCTORALS AND DOCTORAL RESEARCH STAFF IN SCIENCE AND ENGINEERING

HE 011 649

National Academy of Sciences
Washington, D.C
1978

NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the Councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the Committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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ABSTRACT

In the next decade the established research patterns in most scientific disciplines are likely to undergo profound changes as universities, the principal locus for basic research, cope with stabilizing undergraduate and graduate enrollments and tighten research budgets. Already on many campuses increasing numbers of Ph.D. scientists and engineers have been hired in temporary postitions not considered to be part of the regular tenure track. Included in this group are postdoctoral appointees, doctoral research staff, and other nonfaculty staff not primarily involved in research. This report focuses on the doctoral research staff component--those scientists and engineers who are neither postdoctoral appointees nor members of the faculty and who are principally engaged in research.

Highlights from the information available on the doctoral research staff group include:

- In 1977 the group was comprised of approximately 4,200 persons, representing 3 percent of all Ph.D. scientists and engineers employed in academia.
- More than half of the doctoral research staff were employed in the biosciences or physics.
- Between 1975 and 1977 the numbers holding research staff positions increased 20 percent, compared with an 8 percent growth in faculty.
- The doctoral research staff group, while still small in total number, is disproportionately important for research.
- In many universities members of the groups are treated as second class citizens with respect to privileges and conditions of employment.

A detailed statistical analysis of the demographic characteristics and employment situations of doctoral research staff is presented in this report. Although much information is available on the group, members of the Committee and those who participated in the conference recognize the pressing need to obtain a better understanding of this important segment of the academic research community in order to address research policy questions.

ACKNOWLEDGMENTS

The Committee is most appreciative of the input received from the many university deans, department chairmen, and other members of the scientific community it has contacted during the past year. In particular, the Committee acknowledges the contributions provided by the 17 participants (see Appendix C) in the conference it held on the changing role of doctoral research staff in academic research.

Within the Commission on Human Resources, Harrison Shull, Chairman of the Commission, and William C. Kelly, its Executive Director, offered guidance during all phases of the study. Dorothy M. Gilford served as the principal investigator for the project and was responsible for the general administration of the study. Porter E. Coggeshall directed the day-to-day activities of the Committee and had primary responsibility for drafting this report. He was ably assisted by Robert K. Weatherall who served as consultant. Prudence W. Brown produced the voluminous tables and figures used in the report. The Committee is also indebted to other members of the Commission's staff, Marie Clark and Susan Henry, who helped with the preparation of the final text.

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CONTENTS

		PAGE
I.	OVERVIEW OF THE STUDY	1
II.	IDENTIFICATION OF DOCTORAL RESEARCH STAFF	9
III.	CHARACTERISTICS AND EMPLOYMENT OF 1977 DOCTORAL RESEARCH STAFF	19
	Demographic Characteristics	22
	Graduate Training	24
	Postdoctoral Training	25
	Employment Status	26
	Employer	27
	Work Activities	28
	Salary Profile	29
	Sources of Support	30
	Field-Mobility	31
IV.	RECENT GROWTH IN DOCTORAL RESEARCH STAFF	33
	Trends in Full-Time Academic Research Personnel	42
	Trends in Institution of Employment	43
	Trends in Federal Support	44
	Trends in Demographic Characteristics	45
V.	IMPLICATIONS OF THE CHANGING ROLE OF DOCTORAL RESEARCH STAFF IN ACADEMIC RESEARCH	47
	Expected Increases in Doctoral Research Staff	47
	Contributions to Programs of Research	50
	Status in the University	54
	Career Prospects	58
	Need for Further Study	61
	APPENDIXES (see separate Table of Contents)	

LIST OF TABLES AND FIGURES

		PAGE
FIGURE 1	Percentage Growth During the 1973-75 Period and 1975-77 Period in the Number of Ph.D. Scientists and Engineers Employed by Universities in Faculty and Nonfaculty Positions	3
TABLE 1	Number of Ph.D. Scientists by Employment Positions and Field of Science, 1977	13
TABLE 2	Examples of Titles of Positions Held by Academic Staff in Selected Fields of Science Who Did Not Have Fauclty or Postdoctoral Appointments	14
TABLE 3	Percentage of Time Devoted to Research by Academic Staff Not Holding Faculty or Postdoctoral Appointments, 1977	16
TABLE 4	Primary Work Activity of Academic Staff Not Holding Faculty or Postdoctoral Appointments, 1977	16
TABLE 5	Sex, Country of Origin, and Racial/Ethnic Group of Doctoral Research Staff, Compared with Faculty Involved in Research, 1977	22
TABLE 6	Age and Year of Ph.D. of Doctoral Research Staff, Compared with Faculty Involved in Research, 1977	23
TABLE 7	Roose-Andersen Rating of Ph.D. Granting Department of Doctoral Research Staff, Compared with Faculty Involved in Research, 1977	24
TABLE 8	Prior Postdoctoral Training Experience of Doctoral Research Staff and Faculty Involved in Research with 1970-76 Ph.D.'s	25
TABLE 9	Employment Status of Doctoral Research Staff, Compared with Faculty Involved in Research, 1977	26
TABLE 10	Institution of Employment of Doctoral Research Staff, Compared with Faculty Involved in Research, 1977	27
TABLE 11	Average Time Devoted to Research and Other Work Activities by Doctoral Research Staff and Faculty Involved in Research, 1977	28
TABLE 12	Median Salary of Full-Time Doctoral Research Staff, Compared with Faculty Involved in Research, 1977	29
TABLE 13	Federal Sources of Support for Doctoral Research Staff, Compared with Faculty Involved in Research, 1977	30
TABLE 14	Field Switching by Doctoral Research Staff, Compared with Faculty Involved in Research, 1977	31

PAGE

TABLE 15 Growth in the Number of Ph.D. Scientists and Engineers Employed in Academia and Other Sectors, 1973 to 1977 34

FIGURE 2 Percent of Academic Personnel Holding Nonfaculty Staff Positions in Science and Engineering, 1977 40

TABLE 16 Trends in Employment Positions of Full-Time Academic Staff Primarily Engaged in Research in Science and Engineering, 1973 to 1977 42

TABLE 17 Trends in Employment Institutions of Doctoral Research Staff in Science and Engineering, 1973 to 1977 43

TABLE 18 Trends in Federal Sources of Support for Doctoral Research Staff, 1973 to 1977 44

TABLE 19 Trends in Years Since Award of Doctoral Research Staff, 1973 to 1977 45

TABLE 20 Trends in Sex and Country of Origin of Doctoral Research Staff, 1973 to 1977 46

I. OVERVIEW OF THE STUDY

This report describes the current situation of doctoral research staff in academe and comments on probable trends affecting this group. This group is comprised of university-employed Ph.D. scientists and engineers who are considered neither postdoctoral appointees (temporary trainees) nor members of the faculty, and who are principally involved in research activities. In 1977 the group included an estimated 4,200 individuals and represented 3 percent of the total number of Ph.D. scientists and engineers employed in the academic sectors (see Table 1 in this chapter).

The study is part of a larger investigation undertaken by the Committee on Postdoctorals and Doctoral Research Staff in Science and Engineering. The Committee was appointed in the Fall of 1977 by the Commission on Human Resources of the National Research Council to study the changing roles of postdoctorals and doctoral research staff in the United States. To this end the Committee has analyzed existing data from national surveys; solicited the written views of leaders of research in the academic, industrial, and national laboratory communities; and conducted in-depth interviews with many of these leaders as well as with young Ph.D. scientists and graduate students. A preliminary report[1] on postdoctorals was submitted to the National Science Foundation in June 1978, and a final report is scheduled for March 1980. The description that follows of doctoral research staff is intended to complement the postdoctoral reports.

The motivation for this study of academic doctoral research staff is fully described in the study proposal (dated August 30, 1977) and may be summarized

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[1]National Research Council, "Interim Report and Proposal for Continuation of Study of Postdoctorals in Science and Engineering in the United States," June 28, 1978.

as follows. Between 1970 and 1976 funds for scientific research in universities and colleges grew only 8.7 percent in constant dollars.[2] During this same period the number of graduate students employed as research assistants increased only about 4 percent[3] and the total number of university scientists and engineers engaged primarily in research (including doctoral and non-doctoral personnel) grew less than 6 percent.[4] On many campuses increasing numbers of scientists and engineers have been hired in temporary research appointments not considered to be part of the regular tenure track, and there is reason to expect this trend to continue.[5] In the next decade the established research patterns in most scientific disciplines are likely to undergo profound changes as universities, the principal locus for basic research, cope with stabilizing undergraduate and graduate enrollments and tighter research budgets. Some changes in university employment have already been observed. As shown in Figure 1, the numbers of Ph.D. scientists and engineers holding postdoctoral appointments, research staff positions, and other nonfaculty appointments have grown considerably faster than faculty during the 1973-77 period. The total nonfaculty group in science and engineering had a two-year growth of 16 percent between 1973 and 1975 and 19 percent between 1975 and 1977. The corresponding growth rates for faculty were only 14 percent and 8 percent. The doctoral research component

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[2]National Science Foundation, National Patterns of R and D Resources (Government Printing Office, Washington, D.C., 1976), p. 28.

[3]National Science Foundation, Graduate Science Education Student Support and Postdoctorals, Fall 1970 and Fall 1976 (Government Printing Office, Washington, D.C., 1971 and 1977), Table B-11.

[4]National Science Foundation, Manpower Resources for Scientific Activities at Universities and Colleges (Government Printing Office, Washington, D.C., 1977), Table B-2.

[5]Bruce L.R. Smith and Joseph Karlesky, The Universities in the Nation's Research Effort (Change Magazine Press, New York, 1977), pp. 237-8.

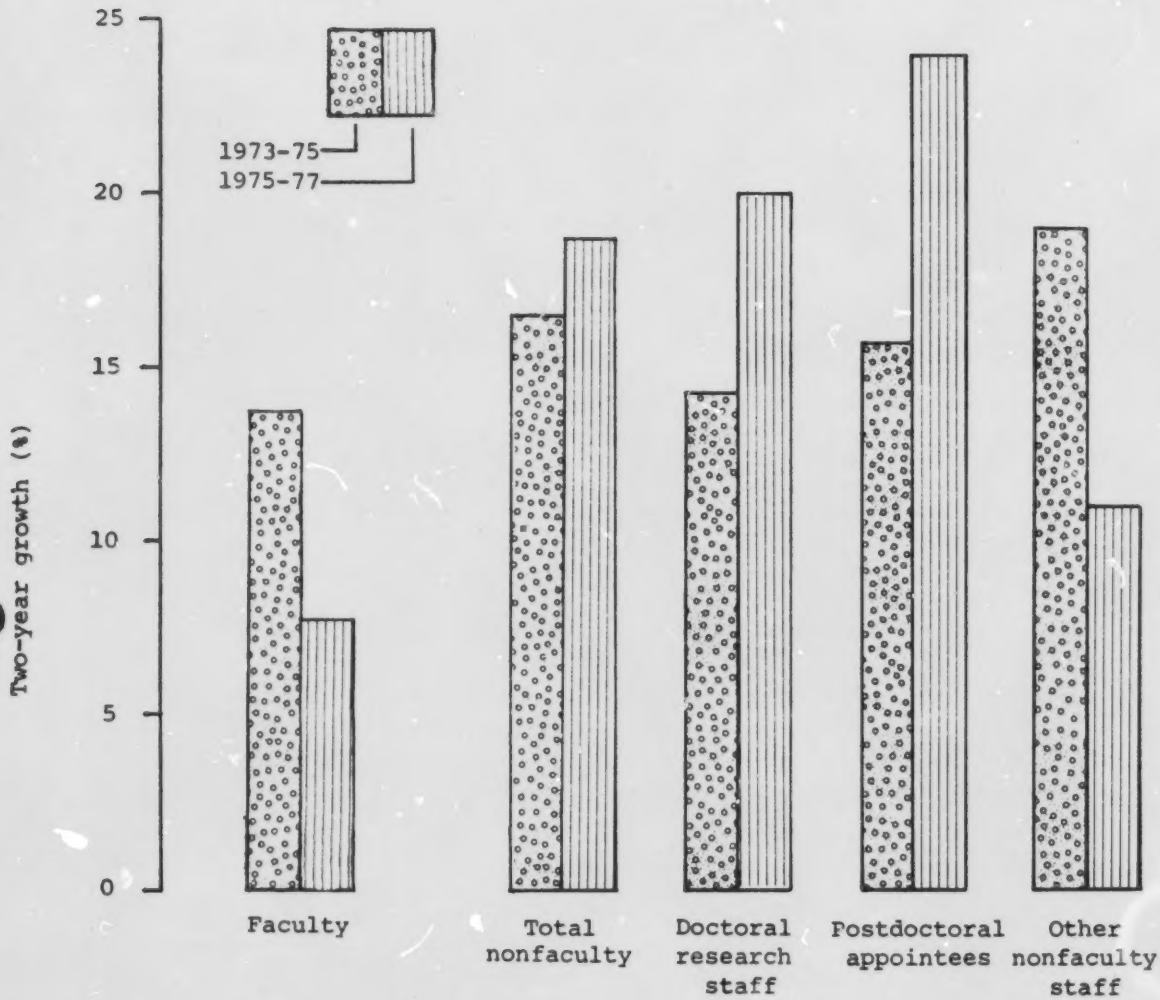

FIGURE 1 Percentage growth during the 1973-75 period and 1975-77 period in the number of Ph.D. scientists and engineers employed by universities in faculty and nonfaculty positions. Growth percentages calculated from data in Table 15 in Chapter IV.

experienced a net increase of 14 percent during the 1973-75 period and 20 percent during the 1975-77 period. While overall size of the nonfaculty staff is still relatively small in some sciences (see Table 15 in Chapter IV), nonfaculty growth exceeded faculty growth in every field during those four years. With these changes it is likely that federal and university policy-makers will assess the various roles that doctoral research staff and other groups may play in academic research in the coming decade. The purpose of the present study is to provide data describing recent trends in both the size and character of the doctoral research group. With this information policy-makers will be in a better position to decide what issues should be addressed and what further studies may be needed to address these issues.

In undertaking the present study the Committee has been specifically requested to carry out the following tasks:

(1) prepare a statistical description of academic doctoral research staff, derived from data already available, and commentary on the status of the group;

(2) describe the current situation of doctoral research staff and comment on probable trends affecting this group;

(3) assess the contribution of doctoral research staff to the research effort in United States universities; and

(4) discuss the implications of significant trends for the future, based on communications with departments and university administrators and on a final conference.

The Committee's report has been separated into four parts. A description of who is included in this group (according to the Commmittee's definition) is given in Chapter II. Detailed analyses of the demographic characteristics, educational background, and 1977 employment situations of the doctoral

research staff are presented in Chapter III. Recent changes in the overall size, characteristics, and employment of these staff members are examined in Chapter IV. Consideration is given in Chapter V to the expected growth of the doctoral research group and to some of the possible implications of this growth. Since information concerning the changing role of doctoral research staff in academic research is still incomplete, no policy recommendations are made in this report.

At the outset it is essential to emphasize that this is the first national study of doctoral research staff in universities and that no survey targeted to this group has yet been undertaken. It therefore is not surprising that the present report has serious shortcomings. Defining the group is difficult. The doctoral research staff populations within most fields are small, and the data from sample surveys have large uncertainties. Existing information illuminate only some facets of the role of these staff members; important information about job responsibilities and privileges, for example, has not yet been collected. No data at all are available on the numbers of professional doctorate recipients (M.D., D.V.M., etc.), foreign university Ph.D. recipients, and non-doctorate level personnel holding research staff appointments in United States universities. Nonetheless, these shortcomings do not obscure the essential conclusions that the doctoral research staff is a growing population important to the vitality of research in universities.

Much of the information presented in the chapters that follow comes from two national surveys conducted by the Commission on Human Resources of the National Research Council. One of these is a biennial survey[6] of a sample of 80,000 Ph.D. recipients in science, engineering, and the humanities, and

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[6]The Survey of Doctorate Recipients is sponsored by the National Science Foundation, the National Institutes of Health, and the National Endowment for the Humanities.

contains detailed information on their current employment situations. Survey data are available on each year's employment during the 1972-75 period and on 1977 employment. Survey responses have been weighted to provide estimates of the total population of Ph.D. recipients who had graduated from United States universities since 1930. A study of possible nonresponse bias in survey results is now being undertaken by the Commission on Human Resources. The other is an annual survey[7] of that year's recipients of Ph.D. degrees (or equivalent research doctorates) in all fields of learning and gathers data on their demographic characteristics, educational background, graduate training, and postgraduation plans. The file developed from this survey includes nearly complete data from all 1958-77 doctorate recipients and limited information from other sources for all 1920-57 graduates.

The Committee initiated several information-gathering activities of its own to obtain a broader perspective on issues related to postdoctorals and doctoral research staff. A letter[8] was sent to 280 department chairmen and deans requesting their comments on some specific issues the Committee was considering. While recipients of this letter were not selected on the basis of a scientific sampling, an effort was made to include individuals who were actively involved in research in a diverse set of fields and institutions and who represented a broad geographic distribution. The response to the Committee's open-ended request has been satisfying; more than 150 answers have been received. Many of these contained detailed comments on several issues, along with materials describing university policies concerning postdoctorals and doctoral research staff. Additional information has been gathered from site

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[7]The Survey of Earned Doctorates is sponsored by the National Science Foundation, the United States Office of Education, the National Institutes of Health, and the National Endowment for the Humanities.

[8]A copy of this letter and a list of recipients are included in Appendix A.

visits to more than 50 groups[9] at 15 different institutions. In these visits lengthy discussions were held with deans, faculty, postdoctoral appointees, doctoral research staff, and graduate students in their last year of training. One or more Committee members accompanied project staff on almost all of the visits. These discussions afforded an opportunity to probe beyond the raw data into the different roles postdoctoral appointees and doctoral research staff play in research in a variety of institutional and departmental settings. The visits also provided input from graduate students, postdoctorals, and doctoral research staff members themselves, who often presented a somewhat different picture from that of the faculty members. Finally, the Committee held a conference[10] on the changing role of doctoral research staff in academic research. Discussions focussed on the expected changes in that role in the coming decade and the probable consequences of those changes for federal and academic institutions and for the research staff members themselves. The insight obtained from the conference and other information-gathering activities undertaken by the Committee contributed in a major way to Chapter V.

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[9] A list of institutions and departments visited is included in Appendix B, along with some examples of questions asked.

[10] A list of conference participants is included in Appendix C, along with the agenda.

II. IDENTIFICATION OF DOCTORAL RESEARCH STAFF

In the not-too-distant past research in academia was carried out by two reasonably well-defined populations: the graduate students and the faculty. Both populations expanded rapidly until the late 1960's (in the biomedical and behavioral fields this rapid expansion continued into the 1970's). As large numbers of students completed graduate programs, they were hired as instructors and assistant professors, with the expectation that most could remain in academic research as they chose. In recent years, with few faculty openings in most science and engineering fields, universities have been reaching for alternative mechanisms to retain the services of young scholars. One mechanism is the postdoctoral appointment, by which a young scholar is supported for a limited time on the training grant or research funds of his mentor or on his own fellowship award. Appointments are typically for one or two years, but one appointment can follow another so that the young scientist may continue as a "postdoc" for a number of years. Another mechanism for the support of doctoral scientists and engineers is the appointment of teaching staff who are expressly not on the tenure track and are usually appointed to fill short-term instructional needs. A third mechanism is the appointment of "research staff" to assist the principal investigator of a research grant or contract (in some instances these staff members may serve as principal investigators themselves). This appointment is almost always for an unspecified period of time without guarantee of employment if the research funding ceases. Often such appointments are held in a research group outside the departmental structure.

For the purpose of its study, the Committee has developed tentative definitions for both the postdoctoral and doctoral research staff populations

described above. The postdoctoral definition has been adapted from a version used in an earlier study[11] by the National Research Council:

> Postdoctoral appointees are individuals holding temporary appointments at the postdoctoral (post-Ph.D., post-M.D., etc.) level that are intended to provide for continued education and experience in research usually, though not necessarily, under the supervision of a senior mentor. Included are those with appointments in government and industrial laboratories that resemble in their character and objectives postdoctoral appointments in universities. Specifically excluded are individuals with: (1) instructorships and assistant professorships which are understood to be part of the regular series of academic appointments leading to a permanent position within the host institution; (2) visiting professor appointments which fill regular places in the host institution's academic staff; (3) service-oriented research appointments not intended to provide continued education in research; (4) medical internships and residencies not involving research training under the supervision of a senior mentor; (5) status as a graduate student in a second doctoral program; and (6) leave from a permanent position elsewhere.

The Committee has proposed the following definition for other nonfaculty researchers who are not considered to be on postdoctoral appointments:

> Doctoral research staff are individuals with doctorates who conduct or assist in research while employed by educational institutions, but who are neither postdoctoral appointees (as defined above) nor members of the faculty. Included are individuals responsible for computer programming/operations, instrumentation, survey methodology, and other supporting services for research, as well as those who serve as principal investigators. Excluded would be individuals who are not primarily involved in a research-related activity.

As alluded to earlier, there is a third group of university employees who are considered neither faculty nor postdoctoral/doctoral research staff. Many of these individuals hold temporary teaching assignments and may have some

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[11] National Research Council, The Invisible University (Washington, D.C., 1969), pp. 42-5.

involvement in programs of research, although they do not consider research to be their primary activity. At this stage in the study too little is known about this group to provide even a tentative definition.

Although the preceding definitions for postdoctoral appointees and doctoral research staff have already proven to be useful in the Committee's preliminary information-gathering activities and in its analyses of available survey information, greater definitional precision may be required as more is learned about the two groups. Since the definition of the postdoctoral appointees rests in part on the intent of the appointment, it is sometimes difficult to distinguish these individuals from other nonfaculty research staff in universities. Doctoral scientists and engineers take postdoctoral appointments for a variety of reasons and at different stages in their careers. The titles given to postdoctoral appointees vary tremendously from one institution to another, as do the responsibilities and privileges of this group. The same may be said about doctoral research staff. In fact, the definition provided above may understate the calibre of scientists and engineers who are intended to be included as doctoral research staff. A memorandum prepared by a university physics department refers to this category of staff members in the following terms:

> The research areas of some department members have come to involve experiments of long duration, great and increasing instrumental complexity, and extended periods of operation at distant facilities. The first-order need then seems to be for high level technical support. The people who can supply this technical support could in principle be accommodated as Project Associates or in one of the various Specialist positions. But not infrequently the technical support can only be provided by persons who are good and developing physicists who become collaborators in a very real sense.[12]

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[12]From materials sent in response to the Committee's request for information from department chairmen and deans.

Table 1 describes the 1977 employment situations of the estimated total national population of Ph.D. scientists and engineers. Nonfaculty staff in the academic sector have been separated into three categories in accordance with the definitions provided earlier in this chapter. Postdoctoral appointees were identified on the basis of the survey respondent's self-categorization (i.e., those marking the category "postdoctoral appointment: fellowship, traineeship, research associateship, etc."). Research staff were distinguished from other nonfaculty staff on the basis of their primary work activity. While the figures reported are underestimated, for the reason given in the table's footnote, they provide a reasonably accurate perspective on the relative sizes of the labor force components. The three nonfaculty groups made up a total of 7 percent (an estimated 17,185 individuals[13]) of the Ph.D. scientists and engineers; faculty represented 49 percent (an estimated 125,339 individuals). Approximately one-fourth (an estimated 4,163 individuals) of the nonfaculty group were categorized as research staff. The relative sizes of this group varied considerably among fields. Research staff represented nearly 4 percent of the physics work force, but less than 1 percent of the psychology and social science work forces. Moreover, in the fields of mathematics, physics, earth sciences, engineering, agricultural sciences, and social sciences, there were as many doctoral research staff as postdoctoral appointees. In chemistry, the biosciences and psychology, the latter were more common.

The position titles for a small sample of Ph.D. scientists and engineers who held research staff and other nonfaculty positions (excluding postdoctoral

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[13]The estimated population figures presented in the text and tables of this report have not been rounded, although it is recognized that the estimates are not precise (see Appendix D for determining sampling errors of estimates).

TABLE 1 NUMBER OF PH.D. SCIENTISTS BY EMPLOYMENT POSITIONS AND FIELD OF SCIENCE, 1977

1977 FIELD OF SCIENCE		TOTAL EMPL*	ACADEMIA FAC-ULTY	ACADEMIA POST-DOCS	ACADEMIA RSRCH STAFF	ACADEMIA OTHER	OTHER SECTORS FFRDC†	OTHER SECTORS GOVT	OTHER SECTORS INDUS	OTHER SECTORS OTHER
TOTAL ALL FIELDS	N	257972	125339	7628	4163	5394	7442	26893	63119	17994
	%	100.0	48.6	3.0	1.6	2.1	2.9	10.4	24.5	7.0
MATHEMATICS	N	18934	12317	82	188	406	543	1032	3975	391
	%	100.0	65.1	.4	1.0	2.1	2.9	5.5	21.0	2.1
PHYSICS	N	17363	7394	684	673	311	2410	1957	3447	487
	%	100.0	42.6	3.9	3.9	1.8	13.9	11.3	19.9	2.8
CHEMISTRY	N	32367	10451	1226	449	422	879	1948	15707	1285
	%	100.0	32.3	3.8	1.4	1.3	2.7	6.0	48.5	4.0
EARTH SCIENCES	N	12181	4734	288	276	251	390	2880	2901	461
	%	100.0	38.9	2.4	2.3	2.1	3.2	23.6	23.8	3.8
ENGINEERING	N	42049	12162	353	358	468	2449	4369	21123	769
	%	100.0	28.9	.8	.9	1.1	5.8	10.4	50.2	1.8
AGRICULTURAL SCIENCES	N	13780	7337	161	166	325	26	2789	2710	267
	%	100.0	53.2	1.2	1.2	2.4	.2	20.2	19.7	1.9
BIOSCIENCES	N	53440	29301	4140	1521	1304	537	5827	6299	4521
	%	100.0	54.8	7.7	2.8	2.4	1.0	10.9	11.8	8.5
PSYCHOLOGY	N	31535	14521	355	221	961	12	2529	5213	7723
	%	100.0	46.0	1.1	.7	3.0		8.0	16.5	24.5
SOCIAL SCIENCES	N	36323	27122	339	311	946	197	3564	1754	2390
	%	100.0	74.7	.9	.9	2.6	.5	9.9	4.8	6.8

*Figures exclude Ph.D. recipients who had been awarded their degrees during the eight-month period prior to the survey. Since recent graduates are more likely to hold nonfaculty appointments, the figures reported significantly underestimate the actual sizes of these groups.

†Federally funded research and development centers.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 2 Examples of Titles of Positions Held by Academic Staff in Selected Fields of Science Who Did Not Have Faculty or Postdoctoral Appointments

Mathematics (19 cases)

analyst (1)
assistant research scientist (2)
assistant research statistician (1)
director of computer center (1)*
principal computer scientist (1)
programmer (2)
research assistant (1)
research scientist (1)
research staff (1)
research technician (1)
senior institutional research analyst (1)
senior programmer (1)
senior research scientist (1)
staff analyst (1)
staff member (2)
visiting faculty (1)

Physics (40 cases)

assistant astronomer (1)
assistant research physicist (2)
assistant research specialist (1)
assistant scientist (1)
associate research scientist (1)
faculty assistant (1)
junior research physicist (1)
physicist - consultant (1)
program representative (1)*
project associate (1)
project scientist (1)
research assistant (6)
research astronomer (1)*
research astronomer & lecturer (1)
research officer (2)
research physicist (6)
research scientist (4)
research staff physicist (2)
researcher (1)
senior research assistant (1)
senior research physicist (1)
senior research scientist (1)
staff research physicist (1)
visiting scientist (1)

Engineering (40 cases)

assistant engineer (2)
assistant research engineer (2)
assistant scientist (1)
associate engineer (1)
associate scientist (1)
consultant (1)*
consultant in structural dynamics (1)
engineer (1)
group head (1)
part-time technician (1)
project engineer (3)
research assistant (3)
research engineer (11)
research reactor supervisor (1)*
research scientist (2)
research staff (2)
researcher (1)
senior research engineer (1)
specialist (1)
visiting scholar (2)
visiting scientist (1)

Biosciences (40 cases)

assistant biochemist (1)
assistant marine biologist (1)
assistant project coordinator (1)
assistant research neuromorphologist (1)
assistant research scientist (2)
associate scientist (1)
biology department assistant (1)*
biochemical consultant (1)
cancer research scientist (1)
consultant (1)
higher scientific scholar (1)
investigator (1)
lab director (1)
postgraduate biochemist (1)
research assistant (4)
research cell biologist (1)
research scholar (1)
research scientist (1)
research specialist (2)
research staff biologist (1)
research technician (1)
research worker (1)
research virologist (1)
scientific assistant (1)
senior assistant in research (1)
senior investigator (1)
staff associate (1)
staff nurse (1)*
staff scientist (1)
teaching associate (1)*
technical specialist (1)
technician (2)
tutor (1)*
visiting scientist (1)

Psychology (39 cases)

amanuensis (1)
assistant to associate professor (1)*
assistant to professor (1)*
assistant research psychologist (3)
assistant specialist (1)
associate research psychologist (1)
co-investigator (1)
consultant (2)
director of student personnel (1)*
exchange scientist (1)
guest investigator (1)
instructor to professor (1)*
project assistant (1)*
project associate (2)
psychologist (1)
research affiliate (1)
research psychologist (5)
research sociologist (1)
research specialist (1)
research staff (1)
research technician (2)
research trainee (1)
senior psychologist (1)
staff assistant (1)*
staff psychologist (1)*
staff psychologist (2)
study director (1)
visiting associate research scientist (1)
visiting scholar (1)

*Primary work activity was something other than research.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

appointments) in universities are listed in Table 2. Positions for which research was not considered to be the primary work activity have been so designated. As expected, there was considerable variation in position titles within each of the five fields included. The most common titles were "research scientist," "research physicist," "research engineer," etc. In some cases the same title was used for both research staff and other academic staff (e.g., staff psychologist).

The identification of doctoral research staff on the basis of primary work activity is, of course, somewhat arbitrary since other academic staff not holding faculty or postdoctoral appointments may play an important role in programs of research and yet devote a major portion of their time to teaching, administration, and other nonresearch activities. Table 3 presents information on the distribution of time devoted to research by university staff who were neither members of the faculty nor postdoctoral appointees. Approximately 47 percent of these individuals spent at least half of their time in research; another 22 percent had some (lesser) involvement in research activities. In the fields of agricultural sciences, psychology, and the social sciences, however, large fractions of these nonfaculty staff were not doing any research at all. Table 4 describes the primary work activities of this same nonfaculty group. Approximately 46 percent of these Ph.D. scientists and engineers considered research to be their principal activity and accordingly have been classified as "doctoral research staff" (in Table 1 and elsewhere in this report). The remaining group, who have been labeled "other staff," were primarily involved in teaching and administration. In the fields of mathematics and the social sciences, the fraction who were teaching is quite large. In psychology, a sizeable fraction were involved in other activities such as consulting and clinical service.

TABLE 3 PERCENTAGE OF TIME DEVOTED TO RESEARCH BY ACADEMIC STAFF NOT HOLDING FACULTY OR POSTDOCTORAL APPOINTMENTS, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	PERCENTAGE OF TIME SPENT IN RESEARCH* NONE %	01-19 %	20-49 %	≥50 %
TOTAL ALL FIELDS	9557	1269	31.7	7.0	14.9	46.6
MATHEMATICS	594	92	32.7	13.3	20.6	33.4
PHYSICS	984	116	10.5	7.6	12.0	70.0
CHEMISTRY	871	130	33.3	4.3	5.2	57.1
EARTH SCIENCES	527	69	16.5	7.8	9.1	66.7
ENGINEERING	826	79	25.7	8.6	15.7	49.9
AGRICULTURAL SCIENCES	491	50	45.5		25.1	29.4
BIOSCIENCES	2825	453	22.5	6.1	14.3	57.1
PSYCHOLOGY	1182	158	60.3	8.1	15.9	15.7
SOCIAL SCIENCES	1257	122	46.5	7.2	18.7	27.7

TABLE 4 PRIMARY WORK ACTIVITY OF ACADEMIC STAFF NOT HOLDING FACULTY OR POSTDOCTORAL APPOINTMENTS, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	PRIMARY WORK ACTIVITY RSRCH* %	TEACH %	ADMIN %	OTHER %
TOTAL ALL FIELDS	9557	1311	46.0	24.7	14.0	15.4
MATHEMATICS	594	96	32.5	45.8	14.7	6.9
PHYSICS	984	121	69.2	14.1	12.6	4.1
CHEMISTRY	871	134	54.9	27.5	9.8	7.8
EARTH SCIENCES	527	73	56.7	22.2	14.8	6.4
ENGINEERING	826	78	44.6	20.9	25.2	9.2
AGRICULTURAL SCIENCES	491	52	36.6	17.2	17.2	29.9
BIOSCIENCES	2825	467	57.1	16.6	10.4	15.9
PSYCHOLOGY	1182	162	19.3	21.1	17.3	42.3
SOCIAL SCIENCES	1257	128	27.4	50.2	13.2	9.2

*Research activities include basic research, applied research, development of equipment/products/systems/data, and design.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

Using the data available from national surveys, the Committee has estimated that in 1977 there were 4,163 scientists and engineers who fit its operational definition of doctoral research staff (see Table 1). These are individuals who in 1977:

(1) were employed by educational institutions;

(2) held neither faculty nor postdoctoral appointments; and

(3) were primarily involved in research activities.

Other academic staff who were doing some research but did not consider it to be their principal activity have been excluded from the doctoral research staff category. A detailed statistical description of the characteristics and employment situations of this group of 4,163 individuals is presented in the next chapter.

III. CHARACTERISTICS AND EMPLOYMENT OF 1977 DOCTORAL RESEARCH STAFF

Perhaps even more than the postdoctorals, the doctoral research staff may be regarded as an "invisible" population within the academic community. Although the appointment of research staff is by no means a new phenomenon, little has been published heretofore about either the characteristics of this group or the nature of their employment situations. A major reason for their anonymity is that members of the doctoral research staff usually have no formal ties with the university department. Many, in fact, are employed in organized research units outside regular academic departments. Albert Teich, in his recent report on these units, described these staff members in the following terms:

> These individuals, many of whom possess Ph.D.'s, and qualifications comparable to regular faculty members, exist in something of an anomalous state in most universities. Some consider themselves long-term post-doctorals; others are appointed to work on specific projects and remain for follow-up efforts. Some consciously choose the research staff route because they like the freedom and other amenities offered by the university environment, but do not like to teach. Still others are spouses of individuals appointed to the teaching faculty, for whom the university is unwilling or unable to provide faculty positions. In general, these full-time researchers are not eligible for tenure, no matter how long they serve in their positions; they seldom participate in the decision-making bodies of the university (such as the faculty senate); and frequently they are denied other perquisites of academic life (Kruytbosch and Messinger, 1968). They are, as many observers have noted, 'in the university, but not of the university.'[14]

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[14]Albert H. Teich, "Trends in the Organization of Academic Research: The role of ORU's and Full-Time Researchers," report submitted to the National Science Foundation, June 1978, p. 25.

The tables that follow in this chapter provide a profile of the estimated 4,163 scientists and engineers who held doctoral research staff positions in February 1977 (the time of the survey). Included is information about the demographic characteristics of this group, their graduate and postdoctoral training, and their employment situations. For the purposes of comparison, corresponding information has been presented on the estimated 66,658 scientists and engineers who in 1977 were employed in faculty positions and devoted at least 20 percent of their time to research activities. Some important differences between the two groups have been highlighted in the text which accompanies the tables in this chapter. More detailed analysis of the data presented is possible, but has not been attempted here. In comparing doctoral research staff with faculty in a given field, the reader should note that some of the information reported for the 1977 research group is based on a small number of survey responses.[15] In each of the fields except physics, chemistry, and the biosciences fewer than 50 survey respondents indicated that they held doctoral research staff positions. The number of respondents to a particular survey item is shown in the second column of each table.

Comparable tabulations for three other expanding components of the labor force are presented in the Appendixes. These three include scientists and engineers who in 1977 held:

(1) postdoctoral appointments within the academic sector (Appendix E);

(2) other nonfaculty appointments within the academic sector for which research was not considered to be the primary work activity (Appendix F); and

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[15]Estimated sampling errors for data presented in this chapter are given in Appendix D.

(3) positions in federally funded research and development centers (FFRDC's) which involved research as the primary activity (Appendix G).

All three groups have been growing at faster rates than faculty (see Table 15 in Chapter IV), and already are making important contributions to programs of research. The postdoctoral appointees, of course, are directly involved in research activities, and many will take faculty or other academic positions after completing their training. A significant fraction of the "other" non-faculty staff also contribute to the research effort, although they spend most of their time in teaching, administration, or other activities. In 1977 almost half[16] of this group devoted at least some time to research activities. The research group employed in federally funded laboratories has much in common with the doctoral research staff in universities. The FFRDC personnel are supported on research grant and contract funds and have no guarantee of permanent employment. Many of the laboratories in which they work have direct affiliation with universities, e.g., Brookhaven, Lincoln, and Lawrence Berkeley. Consequently, these personnel may be viewed as working within the broad setting of academic research, although they are not considered to be university employees as are doctoral research staff.

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[16]Determined from data presented in Tables 3 and 4 of Chapter II.

Demographic Characteristics

More than 20 percent of all Ph.D. scientists and engineers holding research staff appointments in 1977 were women. Only 8 percent of the faculty who devoted at least 20 percent of their time to research activities were women. In the biosciences and social sciences more than one-fourth of the doctoral research staff were women, and in psychology more than half.

Foreign-born[17] scientists and engineers constituted 18 percent of the doctoral research staff in all sciences and engineering, and only 13 percent of the faculty research group. Almost one-third of the research staff in engineering and agricultural sciences were of foreign origin. Less than 2 percent of either the research staff or the faculty belonged to a racial-ethnic minority group.[18]

TABLE 5 SEX, COUNTRY OF ORIGIN, AND RACIAL/ETHNIC GROUP OF DOCTORAL RESEARCH STAFF, COMPARED WITH FACULTY INVOLVED IN RESEARCH, 1977

DOCTORAL RESEARCH STAFF

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	SEX MALE %	SEX FEML %	EST TOTAL N	ITEM RESP n	GRCUP US NATIVE BORN WHT %	GRCUP NCNWHT %	GRCUP FOREIGN BORN %
TOTAL ALL FIELDS	4163	607	79.6	20.4	4163	596	80.7	.9	18.4
MATHEMATICS	199	30	86.2	13.8	199	28	83.2		16.8
PHYSICS	673	81	97.2	2.8	673	78	85.9		14.1
CHEMISTRY	449	69	86.4	13.6	449	69	77.1		22.9
EARTH SCIENCES	276	41	87.7	12.3	276	41	81.5		18.5
ENGINEERING	358	39	96.9	3.1	358	34	68.9		31.1
AGRICULTURAL SCIENCES	166	23	89.8	10.2	166	23	66.3	3.6	30.1
BIOSCIENCES	1521	267	68.7	31.3	1521	259	77.6	2.0	20.4
PSYCHOLOGY	221	35	45.2	54.8	221	33	98.1		1.9
SOCIAL SCIENCES	311	99	72.7	27.3	311	27	96.5		3.5

FACULTY INVOLVED IN RESEARCH

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	SEX MALE %	SEX FEML %	EST TOTAL N	ITEM RESP n	GRCUP US NATIVE BORN WHT %	GRCUP NCNWHT %	GRCUP FOREIGN BORN %
TOTAL ALL FIELDS	66458	8382	92.0	8.0	66458	8013	85.3	1.4	12.4
MATHEMATICS	5979	783	95.0	5.0	5979	738	83.8	1.1	15.1
PHYSICS	4435	524	98.0	2.0	4435	492	80.0	1.7	18.4
CHEMISTRY	5434	657	95.5	4.5	5434	624	86.6	1.6	11.7
EARTH SCIENCES	2805	359	96.7	3.3	2805	343	86.3	.2	13.5
ENGINEERING	7373	691	99.4	.6	7373	666	79.0	.8	20.2
AGRICULTURAL SCIENCES	4619	537	98.8	1.2	4419	518	91.1	2.1	6.8
BIOSCIENCES	18269	2033	88.6	11.4	18269	2011	86.3	2.4	11.3
PSYCHOLOGY	6137	723	82.8	17.2	6137	684	91.2	2.7	6.2
SOCIAL SCIENCES	11605	1181	87.9	12.1	11605	1137	84.0	2.0	14.0

SOURCE: NRC, Survey of Doctorate Recipients, 1977 and Survey of Earned Doctorates, 1958-76.

[17] Survey data reported in this study include only those scientists and engineers who have earned their Ph.D. degrees at United States universities.

[18] Categorized as minority groups are Black/Negro/Afro-American, American Indian, Spanish-American/Mexican American/Chicano, Puerto Rican-American, and Oriental.

Demographic Characteristics (cont.)

In each of the science and engineering fields the doctoral research staff was considerably younger than the faculty research group. Almost 40 percent of the research staff in all fields were under the age of 35, while only 23 percent of the faculty were that young. Similarly, almost half of the research staff had earned their doctorates within the past five years (1972-76), compared with only one-fourth of the faculty. On the other hand, doctoral research staff were generally older than postdoctoral appointees. Approximately 60 percent of the postdoctorals had received their Ph.D. degrees within the past two years (1975-76),[19] compared with only 18 percent of the research staff.

TABLE 6 AGE AND YEAR OF PH.D. OF DOCTORAL RESEARCH STAFF, COMPARED WITH FACULTY INVOLVED IN RESEARCH, 1977

DOCTORAL RESEARCH STAFF

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	AGE: UNDER 35 %	35-44 %	45 & OVER %	EST TOTAL N	ITEM RESP n	FISCAL YEAR OF PHD: 75-76 %	72-74 %	67-71 %	PRE67 %
TOTAL ALL FIELDS	4162	607	38.8	41.9	19.2	4163	607	17.8	31.9	27.5	22.8
MATHEMATICS	188	30	44.7	38.3	17.0	188	30	34.6	26.1	12.2	27.1
PHYSICS	673	81	50.8	39.7	9.5	673	81	10.4	36.0	35.5	18.1
CHEMISTRY	449	63	42.3	39.0	18.7	449	63	25.4	38.1	16.0	20.6
EARTH SCIENCES	276	41	30.4	53.6	15.9	276	41	11.2	43.8	30.8	14.1
ENGINEERING	358	38	22.9	54.5	22.6	358	38	20.9	24.0	22.3	32.7
AGRICULTURAL SCIENCES	166	23	32.5	21.1	46.4	166	23	13.9	48.8	9.0	31.3
BIOSCIENCES	1521	267	40.4	43.2	16.5	1521	267	17.9	28.5	30.4	23.2
PSYCHOLOGY	221	35	28.5	48.0	23.5	221	35	2.7	25.8	45.7	25.8
SOCIAL SCIENCES	311	29	33.4	43.7	22.8	311	29	28.9	28.3	21.2	21.5

FACULTY INVOLVED IN RESEARCH

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	AGE: UNDER 35 %	35-44 %	45 & OVER %	EST TOTAL N	ITEM RESP n	FISCAL YEAR OF PHD: 75-76 %	72-74 %	67-71 %	PRE67 %
TOTAL ALL FIELDS	66659	8375	22.8	42.2	35.0	66658	8382	8.7	17.2	28.9	45.2
MATHEMATICS	5979	783	34.7	42.6	22.7	5979	783	13.8	18.4	32.7	35.0
PHYSICS	4435	524	15.8	46.1	38.1	4435	524	3.8	10.9	28.5	56.9
CHEMISTRY	5436	657	24.0	40.6	35.4	5436	657	5.9	11.6	28.0	54.5
EARTH SCIENCES	2805	353	20.5	41.6	38.0	2805	353	7.0	19.3	27.6	46.2
ENGINEERING	7373	691	14.9	49.3	35.8	7373	691	8.3	14.2	31.3	46.1
AGRICULTURAL SCIENCES	4619	536	12.4	38.6	49.0	4619	537	6.4	12.2	26.1	55.3
BIOSCIENCES	18269	2932	20.9	42.3	36.8	18269	2933	5.6	17.5	30.0	46.9
PSYCHOLOGY	6137	722	32.6	39.3	28.1	6137	723	11.9	22.5	26.8	38.8
SOCIAL SCIENCES	11605	1177	26.0	39.7	34.3	11605	1181	15.4	21.5	27.0	36.1

SOURCE: NRC, Survey of Doctorate Recipients, 1977 and Survey of Earned Doctorates, 1958-76.

[19] See Table 6 in Appendix E.

Graduate Training

Compared with the faculty research group, a slightly larger fraction of the doctoral research staff had received their graduate training in departments which were rated by peers[20] to be among the strongest in their respective fields. Approximately 22 percent of the research staff and 19 percent of the faculty had graduated from "distinguished" science and engineering departments. Moreover, only 14 percent of both the postdoctorals and other nonfaculty staff[21] had earned their doctorates from this same set of departments.

TABLE 7 ROOSE-ANDERSEN RATING OF PH.D. GRANTING DEPARTMENT OF DOCTORAL RESEARCH STAFF, COMPARED WITH FACULTY INVOLVED IN RESEARCH, 1977

DOCTORAL RESEARCH STAFF

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	DEPARTMENTAL RATING: DISTINGUISHED %	STRONG %	OTHER RATED %	NOT RATED %
TOTAL ALL FIELDS	4163	607	22.1	27.3	23.1	27.6
MATHEMATICS	188	30	20.2	42.6	22.3	14.9
PHYSICS	673	81	36.6	29.9	28.2	5.3
CHEMISTRY	449	63	22.0	23.2	28.5	26.3
EARTH SCIENCES	276	41	18.8	14.1	10.5	56.5
ENGINEERING	359	38	23.7	22.6	15.8	33.9
AGRICULTURAL SCIENCES	166	23	3.6	9.0	13.9	73.5
BIOSCIENCES	1521	267	14.6	29.6	23.9	31.9
PSYCHOLOGY	221	35	15.9	36.7	33.0	14.5
SOCIAL SCIENCES	311	29	43.7	27.0	12.9	16.4

FACULTY INVOLVED IN RESEARCH

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	DEPARTMENTAL RATING: DISTINGUISHED %	STRONG %	OTHER RATED %	NOT RATED %
TOTAL ALL FIELDS	66658	8382	19.0	26.2	28.2	26.6
MATHEMATICS	5979	783	30.0	26.0	31.0	13.0
PHYSICS	4435	524	36.2	24.9	29.7	9.2
CHEMISTRY	5436	657	32.9	30.7	29.7	6.8
EARTH SCIENCES	2805	353	12.7	21.6	22.3	43.4
ENGINEERING	7373	691	15.3	19.1	25.1	40.5
AGRICULTURAL SCIENCES	4619	537	3.5	4.2	11.9	80.4
BIOSCIENCES	18269	2933	12.4	28.1	27.1	32.5
PSYCHOLOGY	6137	723	15.1	39.4	34.0	11.4
SOCIAL SCIENCES	11605	1181	22.8	29.3	34.0	13.9

SOURCE: NRC, Survey of Doctorate Recipients, 1977 and Survey of Earned Doctorates, 1958-76.

[20] Kenneth D. Roose and Charles J. Anderson, A Rating of Graduate Programs (American Council on Education, Washington, D.C., 1970).

[21] See Table 7 in Appendixes E and F.

Postdoctoral Study

Doctoral research staff were considerably more likely than faculty researchers to have had some postdoctoral study experience. Of the estimated 2,649 scientists and engineers who had earned Ph.D. degrees between 1970 and 1976[22] and who were employed in academic research staff positions in 1977, almost 58 percent had previously held postdoctoral appointments. Only 35 percent of the 1970-76 graduates holding faculty research positions in 1977 had had postdoctorals. Approximately 70 percent of the doctoral research staff in the biosciences and physics had held postdoctoral appointments.

Compared to the doctoral research staff, a much smaller fraction of the other nonfaculty scientists and engineers[23] had held postdoctoral appointments. Only 17 percent of the latter group had had postdoctorals.

TABLE 8 PRIOR POSTDOCTORAL TRAINING EXPERIENCE OF DOCTORAL RESEARCH STAFF AND FACULTY INVOLVED IN RESEARCH WITH 1970-76 PH.D.'S

DOCTORAL RESEARCH STAFF

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	HELD POSTDOC %	NO POSTDOC %
TOTAL ALL FIELDS	2649	329	57.8	42.2
MATHEMATICS	116	14	7.4	92.6
PHYSICS	446	52	68.8	31.3
CHEMISTRY	310	33	59.3	40.7
EARTH SCIENCES	204	29	52.9	47.1
ENGINEERING	1[illegible]	20	38.6	61.4
AGRICULTURAL SCIENCES	11[illegible]	12	15.7	84.3
BIOSCIENCES	957	147	71.5	28.5
PSYCHOLOGY	93	9	47.1	52.9
SOCIAL SCIENCES	229	13	35.6	64.4

FACULTY INVOLVED IN RESEARCH

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	HELD POSTDOC %	NO POSTDOC %
TOTAL ALL FIELDS	25676	2264	35.3	64.7
MATHEMATICS	2593	260	14.7	85.3
PHYSICS	1093	128	54.7	45.3
CHEMISTRY	1589	154	62.2	37.8
EARTH SCIENCES	1100	114	28.0	72.0
ENGINEERING	2452	198	20.5	79.5
AGRICULTURAL SCIENCES	1403	105	15.0	85.0
BIOSCIENCES	6717	936	54.5	45.5
PSYCHOLOGY	2834	178	19.2	80.8
SOCIAL SCIENCES	5895	147	8.3	91.7

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

[22]Data on postdoctoral training experience are not available for scientists and engineers who had received Ph.D. degrees prior to 1970.

[23]See Table 8 in Appendix F.

Employment Status

More than 10 percent of the doctoral research staff in science and engineering were employed part-time, compared with less than 1 percent of the faculty research group. Part-time employment was especially common among research staff in the biosciences (14 percent), psychology (25 percent), and the social sciences (16 percent). Approximately three-fourths of the part-time research group in these three fields were women.[24]

An even larger fraction of the other nonfaculty staff were employed less than full-time. Nearly 20 percent of this group[25] held part-time appointments in universities.

TABLE 9 EMPLOYMENT STATUS OF DOCTORAL RESEARCH STAFF, COMPARED WITH FACULTY INVOLVED IN RESEARCH, 1977

DOCTORAL RESEARCH STAFF

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	FULL TIME %	PART TIME %
TOTAL ALL FIELDS	4163	607	89.4	10.6
MATHEMATICS	198	30	96.3	3.7
PHYSICS	673	81	95.8	4.2
CHEMISTRY	449	63	92.4	7.6
EARTH SCIENCES	276	41	94.2	5.8
ENGINEERING	359	38	89.9	10.1
AGRICULTURAL SCIENCES	166	23	95.8	4.2
BIOSCIENCES	1521	267	86.4	13.6
PSYCHOLOGY	221	35	74.7	25.3
SOCIAL SCIENCES	311	2[illegible]	84.2	15.8

FACULTY INVOLVED IN RESEARCH

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	FULL TIME %	PART TIME %
TOTAL ALL FIELDS	66659	8382	99.3	.7
MATHEMATICS	5979	783	98.9	1.1
PHYSICS	4435	524	99.7	.3
CHEMISTRY	5436	657	99.5	.5
EARTH SCIENCES	2805	353	99.4	.6
ENGINEERING	7373	691	99.6	.4
AGRICULTURAL SCIENCES	4619	537	99.8	.2
BIOSCIENCES	18269	2933	99.2	.8
PSYCHOLOGY	6137	723	99.1	.9
SOCIAL SCIENCES	11605	1181	98.9	1.1

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

[24]This finding is based on unpublished data from the 1977 Survey of Doctorate Recipients; there were not enough survey response cases to provide a reliable estimate of the part-time employed women in each field.

[25]See Table 9 in Appendix F.

Employer

Since most doctoral research staff were supported by research grant and contract funds, it is not surprising that these staff members were found to be concentrated in the universities which had the greatest research expenditures. More than half of the scientists and engineers in this group were employed by the 25 universities with the largest total R and D expenditures in fiscal year 1976.[26] Only about one-fifth of the faculty researchers worked at these same universities. An earlier study[27] of organized research units in academia noted that large numbers of nonfaculty research staff were employed outside the departmental structure. Some of these personnel worked in laboratories within the university setting; others worked in national laboratories affiliated with universities. As noted earlier in this chapter, members of the latter group have not been included as doctoral research staff in this report[28] since they are generally not regarded to be university employees.

TABLE 10 INSTITUTION OF EMPLOYMENT OF DOCTORAL RESEARCH STAFF, COMPARED WITH FACULTY INVOLVED IN RESEARCH, 1977

DOCTORAL RESEARCH STAFF

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	EMPLOYER TOP 25 RED UNIV %	EMPLOYER NEXT 25 RED UNIV %	EMPLOYER OTHER COLL/ UNIV %
TOTAL ALL FIELDS	4163	607	51.6	13.1	35.3
MATHEMATICS	188	30	30.3	13.3	56.4
PHYSICS	673	81	57.7	11.4	30.9
CHEMISTRY	445	63	34.1	20.3	45.7
EARTH SCIENCES	276	41	51.8	9.1	39.1
ENGINEERING	358	38	42.5	10.1	47.5
AGRICULTURAL SCIENCES	166	23	52.4	15.7	31.9
BIOSCIENCES	1521	267	56.7	15.4	27.9
PSYCHOLOGY	221	35	47.1	5.4	47.5
SOCIAL SCIENCES	311	29	65.0	6.8	28.3

FACULTY INVOLVED IN RESEARCH

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	EMPLOYER TOP 25 RED UNIV %	EMPLOYER NEXT 25 RED UNIV %	EMPLOYER OTHER COLL/ UNIV %
TOTAL ALL FIELDS	66658	8382	21.7	15.8	62.4
MATHEMATICS	5979	783	21.4	11.7	66.9
PHYSICS	4435	524	23.5	16.2	60.3
CHEMISTRY	5436	657	15.1	11.1	73.8
EARTH SCIENCES	2805	353	20.7	15.3	63.9
ENGINEERING	7373	691	22.8	19.6	57.6
AGRICULTURAL SCIENCES	4619	537	23.3	26.4	50.3
BIOSCIENCES	18269	2933	23.7	18.1	58.2
PSYCHOLOGY	6137	723	20.8	11.4	67.8
SOCIAL SCIENCES	11605	1191	20.7	12.3	66.9

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

[26]Based on total research expenditures as reported in Table B-21 in Expenditures for Scientific Activities at Universities and Colleges, Fiscal Year 1976 (National Science Foundation, 1977).

[27]Teich, op. cit., p. 7.

[28]See tables in Appendix G for a description of this group.

Work Activities

Since research was the primary work activity of all doctoral research staff members (by definition), it is not surprising to find that they spent considerably more time on research activities[29] than the faculty group. An average of nearly 80 percent of a research staff member's time was devoted to these activities, while only 5 percent was spent in teaching. Unpublished data indicate that 75 percent of the doctoral research staff were not involved in any teaching at all. The faculty group, which included only those spending at least 20 percent of their time in research, devoted about the same fraction of time to teaching as to research. Very few faculty researchers (less than 11 percent) did no teaching at all.

TABLE 11 AVERAGE TIME DEVOTED TO RESEARCH AND OTHER WORK ACTIVITIES BY DOCTORAL RESEARCH STAFF AND FACULTY INVOLVED IN RESEARCH, 1977

DOCTORAL RESEARCH STAFF

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	AVERAGE % TIME IN RSRCH	TEACH	ADMIN	OTHER
TOTAL ALL FIELDS	4163	589	78.6	5.5	6.4	9.5
MATHEMATICS	188	29	70.5	16.7	5.9	6.9
PHYSICS	673	79	78.2	3.6	10.1	8.1
CHEMISTRY	449	62	86.6	3.9	5.2	4.3
EARTH SCIENCES	276	40	78.5	4.7	7.5	9.3
ENGINEERING	358	38	74.7	5.8	10.2	9.3
AGRICULTURAL SCIENCES	166	21	72.9	6.4	2.0	18.7
BIOSCIENCES	1521	257	83.6	3.9	4.0	8.5
PSYCHOLOGY	221	34	62.5	10.4	10.0	17.1
SOCIAL SCIENCES	311	29	67.2	8.7	6.5	17.6

FACULTY INVOLVED IN RESEARCH

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	AVERAGE % TIME IN RSRCH	TEACH	ADMIN	OTHER
TOTAL ALL FIELDS	66658	8382	43.7	39.5	7.6	9.2
MATHEMATICS	5979	783	39.9	49.1	4.7	6.3
PHYSICS	4435	524	44.0	44.3	8.2	3.5
CHEMISTRY	5436	657	43.6	42.2	7.4	6.8
EARTH SCIENCES	2805	353	41.7	38.4	12.1	7.8
ENGINEERING	7373	691	39.4	42.6	10.0	8.0
AGRICULTURAL SCIENCES	4619	537	55.3	28.3	5.8	10.6
BIOSCIENCES	18269	2933	50.3	32.0	8.4	9.3
PSYCHOLOGY	6137	723	37.5	39.9	7.4	15.2
SOCIAL SCIENCES	11605	1181	37.3	45.7	6.0	11.0

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

[29]Research activities include basic research, development of equipment/products/systems/data, and design.

Salary Profile

Since the research staff were considerably younger (as shown in Table 6) and less experienced than faculty, it is not surprising to find that the median salary[30] of the research staff ($18,050) was significantly below that of faculty researchers ($23,650) in science and engineering. For the 1972-76 Ph.D. recipients, the difference in the median salaries of the two groups was smaller ($17,050 compared with $18,700), but nonetheless significant.

Doctoral research staff salaries substantially exceeded postdoctoral stipends and were approximately comparable with salaries for other nonfaculty staff. Postdoctoral appointees with 1972-76 Ph.D.'s received a median stipend of $11,600;[31] other nonfaculty staff in this cohort earned a median salary of $17,500.[32]

TABLE 12 MEDIAN SALARY OF FULL-TIME DOCTORAL RESEARCH STAFF, COMPARED WITH FACULTY INVOLVED IN RESEARCH, 1977

DOCTORAL RESEARCH STAFF

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	ALL YEARS	72-76 PHDS	67-71 PHDS	62-66 PHDS	PRE62 PHDS
TOTAL ALL FIELDS	3723	475	$18,050	$17,050	$18,200	$22,400	$24,250
MATHEMATICS	181	21	17,800	*	*	*	*
PHYSICS	645	70	18,500	18,150	18,400	*	*
CHEMISTRY	415	49	17,450	16,600	*	*	*
EARTH SCIENCES	260	35	18,200	17,150	*	*	*
ENGINEERING	322	32	20,000	18,350	*	*	*
AGRICULTURAL SCIENCES	159	16	19,950	*	*	*	*
BIOSCIENCES	1314	208	17,050	16,200	17,200	18,800	24,300
PSYCHOLOGY	165	22	18,150	*	*	*	*
SOCIAL SCIENCES	262	22	20,950	*	*	*	*

*Median salaries based on fewer than 15 individuals are not reported.

FACULTY INVOLVED IN RESEARCH

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	ALL YEARS	72-76 PHDS	67-71 PHDS	62-66 PHDS	PRE62 PHDS
TOTAL ALL FIELDS	66166	7962	$23,650	$18,700	$22,350	$25,950	$31,400
MATHEMATICS	5916	741	23,050	18,450	22,200	26,000	32,900
PHYSICS	4421	504	24,450	18,150	21,150	25,700	31,750
CHEMISTRY	5408	618	23,200	18,150	20,800	24,050	30,750
EARTH SCIENCES	2789	329	23,200	18,300	22,150	25,450	32,150
ENGINEERING	7346	665	25,850	20,050	25,100	27,900	33,900
AGRICULTURAL SCIENCES	4608	517	23,400	19,500	22,050	24,250	26,850
BIOSCIENCES	18117	2776	23,750	19,200	22,150	25,800	30,300
PSYCHOLOGY	6084	685	22,200	18,050	22,000	25,500	31,750
SOCIAL SCIENCES	11477	1127	23,150	18,600	23,100	28,000	33,450

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

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[30]Salaries reported for an academic (9-10 month) year have been adjusted to full-year equivalents.

[31]See Table 12 in Appendix E.

[32]See Table 12 in Appendix F.

Sources of Support

The heavy dependence of the doctoral research staff on federal grants and contracts is clearly reflected in the survey findings. Nearly 83 percent of this group received at least some federal funding of their work. Approximately 33 percent were supported by NIH, 23 percent by NSF, and 12 percent by ERDA. NASA provided support for 9 percent of the research staff members, primarily in the physical sciences and engineering. In contrast to these figures, almost half of the science and engineering faculty research group received no federal funding at all.

A recent study[33] of nontenure-track personnel in seven biomedical and related fields reported that less than half of them were eligible (according to university and departmental guidelines) to apply for federal support as principal investigators and that only 10 percent had received support in the past year (1976-77) as principal investigators.

TABLE 13 FEDERAL SOURCES OF SUPPORT FOR DOCTORAL RESEARCH STAFF, COMPARED WITH FACULTY INVOLVED IN RESEARCH, 1977

DOCTORAL RESEARCH STAFF

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	AC FEDL SUPT %	SOME FEDL SUPT %	SUPPORTING AGENCY DOA %	DOD %	EPA %	ERDA %	NASA %	NIH %	NSF %	OTHERS %
TOTAL ALL FIELDS	4163	588	17.1	82.9	3.1	9.0	2.1	11.5	9.0	33.4	22.6	12.1
MATHEMATICS	198	30	51.6	48.4		21.8		1.1	3.7	6.9	15.4	6.4
PHYSICS	673	79	7.7	92.3		13.4		37.1	31.2	3.4	32.0	.8
CHEMISTRY	449	61	14.6	85.4	4.9	7.7		13.9	10.4	27.8	30.2	8.4
EARTH SCIENCES	276	41	17.0	83.0		20.7	3.3	10.5	12.0	3.6	44.9	23.6
ENGINEERING	358	38	15.9	84.1		25.1	5.9	27.1	15.1	3.9	32.1	13.7
AGRICULTURAL SCIENCES	144	22	37.9	62.1	47.2			3.7			11.2	
BIOSCIENCES	1521	257	14.3	85.7	1.8	.7	2.2	1.8	1.4	71.4	15.0	8.3
PSYCHOLOGY	221	33	19.2	80.8		9.1	5.3			41.3	5.8	37.0
SOCIAL SCIENCES	311	28	22.2	77.8			4.0			12.5	19.2	42.1

FACULTY INVOLVED IN RESEARCH

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	AC FEDL SUPT %	SOME FEDL SUPT %	SUPPORTING AGENCY DOA %	DOD %	EPA %	ERDA %	NASA %	NIH %	NSF %	OTHERS %
TOTAL ALL FIELDS	66658	8307	47.8	52.2	8.4	4.5	2.0	4.3	2.3	19.6	14.6	10.4
MATHEMATICS	5979	779	72.6	27.4	.3	6.2	.5	1.6	.8	2.3	17.5	3.0
PHYSICS	4435	521	45.4	54.4		7.3	.7	15.8	6.6	2.4	32.9	2.3
CHEMISTRY	5436	652	48.9	51.1	2.0	7.2	1.8	4.8	3.5	24.6	19.9	4.5
EARTH SCIENCES	2835	351	38.5	62.0	2.8	12.7	6.4	8.2	8.8	1.6	39.6	17.3
ENGINEERING	7373	690	36.3	63.7	3.7	13.5	5.5	11.9	8.0	8.7	20.3	16.1
AGRICULTURAL SCIENCES	4619	533	19.1	80.9	70.9	.8	3.8	2.3	.1	1.9	4.9	11.1
BIOSCIENCES	18269	2994	33.2	66.8	7.9	1.1	1.9	2.4	.6	46.1	11.7	7.7
PSYCHOLOGY	6137	711	61.7	38.3	.9	1.5	.2	.5	.4	17.8	6.7	17.3
SOCIAL SCIENCES	11605	1165	71.9	28.1	3.0	1.9	.5	.9	.1	4.6	6.3	15.1

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

[33] Irene L. Gomberg and Frank J. Atelsek, Nontenure-Track Personnel Opportunities For Self-Initiated Research (American Council on Education, Washington, D.C., 1978), Table 3.

Field-Mobility

Although younger and less experienced,[34] doctoral research staff switched fields more frequently than faculty researchers. More than 60 percent of the research staff were employed in fields other than their Ph.D. specialty, and 24 percent were engaged in research outside the broad field[35] of their doctorate. In contrast, only 11 percent of the faculty research group were employed in areas outside their broad field of graduate training. One possible explanation for these findings is that the doctoral research staff position has been used by some scientists and engineers as a means of switching into different areas of research, because of either new interests or the unavailability of positions in their Ph.D. field.

TABLE 14 FIELD SWITCHING BY DOCTORAL RESEARCH STAFF, COMPARED WITH FACULTY INVOLVED IN RESEARCH, 1977

DOCTORAL RESEARCH STAFF

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	EMPLOYED IN PHD SPECIALTY FIELD %	PHD BROAD FIELD %	OTHER FIELD %
TOTAL ALL FIELDS	4163	607	39.0	37.4	23.6
MATHEMATICS	188	30	13.8	52.7	33.5
PHYSICS	673	81	53.0	38.3	8.6
CHEMISTRY	449	63	25.2	41.2	33.6
EARTH SCIENCES	276	41	40.6	26.8	32.6
ENGINEERING	358	38	36.0	33.2	30.7
AGRICULTURAL SCIENCES	166	23	42.8	43.4	13.9
BIOSCIENCES	1521	267	41.0	37.8	21.2
PSYCHOLOGY	221	35	29.4	50.7	19.9
SOCIAL SCIENCES	311	29	40.2	20.9	38.9

FACULTY INVOLVED IN RESEARCH

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	EMPLOYED IN PHD SPECIALTY FIELD %	PHD BROAD FIELD %	OTHER FIELD %
TOTAL ALL FIELDS	66658	8382	53.3	35.5	11.2
MATHEMATICS	5979	783	47.0	38.4	14.6
PHYSICS	4435	524	48.6	43.5	7.9
CHEMISTRY	5436	657	44.0	41.7	14.2
EARTH SCIENCES	2805	353	35.2	29.4	31.4
ENGINEERING	7373	691	64.1	26.2	9.7
AGRICULTURAL SCIENCES	4619	537	57.7	32.6	9.6
BIOSCIENCES	18769	2933	46.5	42.5	10.9
PSYCHOLOGY	6137	723	59.1	33.7	7.2
SOCIAL SCIENCES	11605	1181	65.2	26.5	8.4

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

[34] An earlier NRC study showed that scientists and engineers in the older cohorts were more likely to have switched out of their fields of graduate training than their younger colleagues. See NRC, Field Mobility of Doctoral Scientists and Engineers (National Academy of Sciences, Washington, D.C., 1975), Figure 4.0, p. 79.

[35] Each of the nine fields listed in the tables is considered a "broad field" for the purposes of this analysis.

IV. RECENT GROWTH IN DOCTORAL RESEARCH STAFF

In the preliminary report on postdoctorals the Committee noted a steady increase in the numbers of science and engineering Ph.D. recipients who have taken research training appointments after earning their degrees.

> In the biosciences, physics, and chemistry more than half of the new doctorate recipients now expect to take postdoctoral appointments. In the earth sciences this fraction is considerably smaller, but has risen significantly in the last ten years. If recent trends continue, by 1985 more than one-third of the doctoral graduates in this field will pursue postdoctoral study. Other fields show a more modest, but nonetheless significant, growth.[36]

The recent increases in doctoral research staff in science and engineering have almost matched the postdoctoral growth. As shown in Figure 1 (Chapter 1), between 1973 and 1977 the total numbers of postdoctorals and doctoral research staff in universities increased by 44 percent and 37 percent, respectively. During this same period the total faculty size grew by less than 23 percent.

Table 15 provides a comprehensive description of the 1973-77 expansion in all employment sectors within each field of science. As explained earlier, the data include only Ph.D. scientists and engineers who graduated from United States universities. The overall growth in the academic sector (24 percent for the four-year period) has been somewhat below that in government (37 percent) and industry (36 percent). The total number of scientists and engineers in federally funded research and development centers has increased at an even faster pace (45 percent). A majority of these FFRDC staff members are believed to be engaged in fundamental research in university-affiliated

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[36] National Research Council, "Interim Report and Proposal for Continuation of Study of Postdoctorals in Science and Engineering in the United States," June 29, 1978, p. 2.

TABLE 15 GROWTH IN THE NUMBER OF PH.D. SCIENTISTS AND ENGINEERS EMPLOYED IN ACADEMIA AND OTHER SECTORS, 1973 TO 1977

TOTAL, ALL FIELDS

	1973	1975	1977	4-YEAR GROWTH(%)
TOTAL LABOR FORCE*	202632	235729	261182	28.9
TOTAL EMPLOYED IN ACADEMIA	114622	130809	142524	24.3
TOTAL FACULTY	102190	116329	125339	22.7
PROFESSOR	41980	47866	50561	20.4
ASSOC. PROFESSOR	30988	35961	39081	26.1
ASST. PROFESSOR	28008	30827	33474	19.5
INSTRUCTOR	1214	1675	2223	83.1
TOTAL NONFACULTY	12432	14480	17185	38.2
DOCTORAL RESEARCH STAFF	3033	3468	4163	37.3
POSTDOCTORALS	5312	6147	7628	43.6
OTHER STAFF	4087	4865	5394	32.0
TOTAL EMPLOYED ELSEWHERE	85607	102581	115448	34.9
FFRDC	5129	6684	7442	45.1
GOVERNMENT	19693	23827	26893	36.6
INDUSTRY	46316	57368	63119	36.3
OTHER SECTORS	14469	14702	17994	24.4
UNEMPLOYED*	2403	2339	3210	33.6

MATHEMATICS

	1973	1975	1977	4-YEAR GROWTH(%)
TOTAL LABOR FORCE*	14011	15969	19102	36.3
TOTAL EMPLOYED IN ACADEMIA	10801	12214	12993	20.3
TOTAL FACULTY	10382	11646	12317	18.6
PROFESSOR	3539	4027	4300	21.5
ASSOC. PROFESSOR	3200	3820	4313	34.8
ASST. PROFESSOR	3524	3587	3391	3.8
INSTRUCTOR	119	212	313	163.0
TOTAL NONFACULTY	419	568	676	61.3
DOCTORAL RESEARCH STAFF	76	123	188	(147.4)
POSTDOCTORALS	71	96	82	(15.5)
OTHER STAFF	272	349	406	49.3
TOTAL EMPLOYED ELSEWHERE	3049	3676	5941	94.9
FFRDC	345	420	543	57.4
GOVERNMENT	657	866	1032	57.1
INDUSTRY	1709	2197	3975	132.6
OTHER SECTORS	338	193	391	15.7
UNEMPLOYED*	161	79	168	4.3

*Figures exclude Ph.D. recipients who had been awarded their degrees during the eight-month period prior to the survey. Since recent graduates are more likely to hold nonfaculty appointments, the figures reported significantly underestimate the actual sizes of these groups.

*Includes only those seeking employment.

NOTE: Growth percentages based on an estimated population of fewer than 100 individuals are reported in parentheses ( ).

SOURCE: NRC, Surveys of Doctorate Recipients, 1973, 1975, 1977.

TABLE 15 CONTINUED

PHYSICS

	1973	1975	1977	4-YEAR GROWTH(%)
TOTAL LABOR FORCE*	15681	16772	17627	12.4
TOTAL EMPLOYED IN ACADEMIA	8247	8560	9062	9.9
TOTAL FACULTY	6813	7036	7394	8.5
PROFESSOR	2843	3094	3315	16.6
ASSOC. PROFESSOR	2015	2409	2419	20.0
ASST. PROFESSOR	1828	1383	1548	-15.3
INSTRUCTOR	127	150	112	-11.8
TOTAL NONFACULTY	1434	1524	1668	16.3
DOCTORAL RESEARCH STAFF	445	543	673	51.2
POSTDOCTORALS	783	616	684	-12.6
OTHER STAFF	206	365	311	15.1
TOTAL EMPLOYED ELSEWHERE	7152	7857	8301	16.1
FFRDC	1798	2157	2410	34.0
GOVERNMENT	1750	2066	1957	11.8
INDUSTRY	3088	3236	3447	11.6
OTHER SECTORS	516	398	487	-5.6
UNEMPLOYED*	282	355	264	-6.4

CHEMISTRY

	1973	1975	1977	4-YEAR GROWTH(%)
TOTAL LABOR FORCE*	27260	31483	32819	20.4
TOTAL EMPLOYED IN ACADEMIA	10097	11980	12548	24.3
TOTAL FACULTY	8474	10139	10451	23.3
PROFESSOR	3621	4563	4772	31.8
ASSOC. PROFESSOR	2545	3083	2941	15.6
ASST. PROFESSOR	2142	2222	2404	12.2
INSTRUCTOR	166	271	334	101.2
TOTAL NONFACULTY	1623	1841	2097	29.2
DOCTORAL RESEARCH STAFF	226	241	449	98.7
POSTDOCTORALS	1044	1165	1226	17.4
OTHER STAFF	353	435	422	19.5
TOTAL EMPLOYED ELSEWHERE	16573	19129	19819	19.6
FFRDC	665	806	879	32.2
GOVERNMENT	1504	1807	1948	29.5
INDUSTRY	13274	15386	15707	18.3
OTHER SECTORS	1130	1130	1285	13.7
UNEMPLOYED*	590	374	452	-23.3

*Figures exclude Ph.D. recipients who had been awarded their degrees during the eight-month period prior to the survey. Since recent graduates are more likely to hold nonfaculty appointments, the figures reported significantly underestimate the actual sizes of these groups.

*Includes only those seeking employment.

NOTE: Growth percentages based on an estimated population of fewer than 100 individuals are reported in parentheses ( ) .

SOURCE: NRC, Surveys of Doctorate Recipients, 1973, 1975, 1977.

TABLE 15 CONTINUED

EARTH SCIENCES

	1973	1975	1977	4-YEAR GROWTH(%)
TOTAL LABOR FORCE*	9621	11287	12262	27.5
TOTAL EMPLOYED IN ACADEMIA	4653	5141	5549	19.3
TOTAL FACULTY	4016	4510	4734	17.9
PROFESSOR	1754	1868	2100	19.7
ASSOC. PROFESSOR	1206	1524	1453	20.5
ASST. PROFESSOR	1037	1083	1166	12.4
INSTRUCTOR	19	35	15	(-21.1)
TOTAL NONFACULTY	637	631	815	27.9
DOCTORAL RESEARCH STAFF	237	296	276	16.5
POSTDOCTORALS	156	196	288	84.6
OTHER STAFF	244	139	251	2.9
TOTAL EMPLOYED ELSEWHERE	4910	6059	6632	35.1
FFRDC	292	408	390	33.6
GOVERNMENT	2229	2578	2880	29.2
INDUSTRY	1959	2702	2901	48.1
OTHER SECTORS	430	371	461	7.2
UNEMPLOYED†	58	87	81	(39.7)

ENGINEERING

	1973	1975	1977	4-YEAR GROWTH(%)
TOTAL LABOR FORCE*	33645	39870	42302	24.9
TOTAL EMPLOYED IN ACADEMIA	11597	12585	13341	15.0
TOTAL FACULTY	10709	11623	12162	13.6
PROFESSOR	4720	5505	5924	25.5
ASSOC. PROFESSOR	3635	3856	3925	8.0
ASST. PROFESSOR	2332	2253	2271	-2.6
INSTRUCTOR	22	9	42	(90.9)
TOTAL NONFACULTY	888	962	1179	32.8
DOCTORAL RESEARCH STAFF	263	356	358	36.1
POSTDOCTORALS	213	142	353	65.7
OTHER STAFF	412	464	468	13.6
TOTAL EMPLOYED ELSEWHERE	21768	27021	28708	31.8
FFRDC	1504	2183	2448	62.8
GOVERNMENT	3068	3853	4368	42.4
INDUSTRY	15987	20467	21123	32.1
OTHER SECTORS	1229	518	769	-37.4
UNEMPLOYED†	260	264	253	-2.7

*Figures exclude Ph.D. recipients who had been awarded their degrees during the eight-month period prior to the survey. Since recent graduates are more likely to hold nonfaculty appointments, the figures reported significantly underestimate the actual sizes of these groups.

†Includes only those seeking employment.

NOTE: Growth percentages based on an estimated population of fewer than 100 individuals are reported in parentheses ( ).

SOURCE: NRC, Surveys of Doctorate Recipients, 1973, 1975, 1977.

TABLE 15 CONTINUED

AGRICULTURAL SCIENCES

	1973	1975	1977	4-YEAR GROWTH(%)
TOTAL LABOR FORCE*	10208	12502	13848	35.7
TOTAL EMPLOYED IN ACADEMIA	6293	7513	7989	27.0
TOTAL FACULTY	5828	6941	7337	25.9
PROFESSOR	2951	3523	3621	22.7
ASSOC. PROFESSOR	1761	1963	2116	20.2
ASST. PROFESSOR	1101	1408	1547	40.5
INSTRUCTOR	15	47	53	(253.3)
TOTAL NONFACULTY	465	572	652	40.2
DOCTORAL RESEARCH STAFF	150	128	166	10.7
POSTDOCTORALS	67	158	161	(140.3)
OTHER STAFF	248	286	325	31.0
TOTAL EMPLOYED ELSEWHERE	3865	4943	5791	49.8
FFRDC	0	11	26	
GOVERNMENT	1914	2277	2788	45.7
INDUSTRY	1702	2419	2710	59.2
OTHER SECTORS	249	236	267	7.2
UNEMPLOYED*	50	46	68	(36.0)

BIOSCIENCES

	1973	1975	1977	4-YEAR GROWTH(%)
TOTAL LABOR FORCE*	44275	49223	54357	22.8
TOTAL EMPLOYED IN ACADEMIA	29848	33274	36266	21.5
TOTAL FACULTY	25192	27888	29301	16.3
PROFESSOR	10043	10931	10924	8.8
ASSOC. PROFESSOR	7410	7984	8891	20.0
ASST. PROFESSOR	7181	8263	8795	22.5
INSTRUCTOR	558	710	691	23.8
TOTAL NONFACULTY	4656	5386	6965	49.6
DOCTORAL RESEARCH STAFF	1185	1276	1521	28.4
POSTDOCTORALS	2613	3264	4140	58.4
OTHER STAFF	858	846	1304	52.0
TOTAL EMPLOYED ELSEWHERE	13951	15363	17174	23.1
FFRDC	388	498	537	38.4
GOVERNMENT	4920	5601	5827	18.4
INDUSTRY	4825	5617	6289	30.3
OTHER SECTORS	3818	3647	4521	18.4
UNEMPLOYED*	476	586	917	92.6

*Figures exclude Ph.D. recipients who had been awarded their degrees during the eight-month period prior to the survey. Since recent graduates are more likely to hold nonfaculty appointments, the figures reported significantly underestimate the actual sizes of these groups.

*Includes only those seeking employment.

NOTE: Growth percentages based on an estimated population of fewer than 100 individuals are reported in parentheses ( ).

SOURCE: NRC, Surveys of Doctorate Recipients, 1973, 1975, 1977.

TABLE 15 CONTINUED

PSYCHOLOGY

	1973	1975	1977	4-YEAR GROWTH(%)
TOTAL LABOR FORCE*	23474	28576	31950	36.1
TOTAL EMPLOYED IN ACADEMIA	13202	15598	16058	21.6
TOTAL FACULTY	11958	14094	14521	21.4
PROFESSOR	4568	5443	5344	17.0
ASSOC. PROFESSOR	3602	4412	4394	22.0
ASST. PROFESSOR	3663	4093	4409	20.4
INSTRUCTOR	125	146	374	199.2
TOTAL NONFACULTY	1244	1504	1537	23.6
DOCTORAL RESEARCH STAFF	297	280	221	-25.6
POSTDOCTORALS	181	320	355	96.1
OTHER STAFF	766	904	961	25.5
TOTAL EMPLOYED ELSEWHERE	10012	12765	15477	54.6
FFRDC	30	37	12	(-60.0)
GOVERNMENT	1944	2245	2529	30.1
INDUSTRY	2750	3909	5213	89.6
OTHER SECTORS	5288	6574	7723	46.0
UNEMPLOYED*	260	213	415	59.6

SOCIAL SCIENCES

	1973	1975	1977	4-YEAR GROWTH(%)
TOTAL LABOR FORCE*	24457	30047	36915	50.9
TOTAL EMPLOYED IN ACADEMIA	19884	23944	28718	44.4
TOTAL FACULTY	18818	22452	27122	44.1
PROFESSOR	7941	8912	10261	29.2
ASSOC. PROFESSOR	5614	6910	8629	53.7
ASST. PROFESSOR	5200	6535	7943	52.8
INSTRUCTOR	63	95	289	(358.7)
TOTAL NONFACULTY	1066	1492	1596	49.7
DOCTORAL RESEARCH STAFF	154	225	311	101.9
POSTDOCTORALS	184	190	339	84.2
OTHER STAFF	728	1077	946	29.9
TOTAL EMPLOYED ELSEWHERE	4307	5768	7605	76.6
FFRDC	107	164	197	84.1
GOVERNMENT	1707	2534	3564	108.8
INDUSTRY	1022	1435	1754	71.6
OTHER SECTORS	1471	1635	2090	42.1
UNEMPLOYED*	266	335	592	122.6

*Figures exclude Ph.D. recipients who had been awarded their degrees during the eight-month period prior to the survey. Since recent graduates are more likely to hold nonfaculty appointments, the figures reported significantly underestimate the actual sizes of these groups.

*Includes only those seeking employment.

NOTE: Growth percentages based on an estimated population of fewer than 100 individuals are reported in parentheses ( ).

SOURCE: NRC, Surveys of Doctorate Recipients, 1973, 1975, 1977.

laboratories and might be considered part of the academic community, although they are generally not regarded as university employees.[37] Within the academic sector there have been significant increases in all three categories of nonfaculty positions as well as in instructorships. The 83 percent jump in the latter reflects an increase in the number of Ph.D. recipients holding instructorships, and not necessarily an increase in the total number of instructors (a majority of the instructorships in colleges and junior colleges are held by non-Ph.D. personnel).

A comparison of growth patterns of the nonfaculty group in each science and engineering field reveals some important differences. In mathematics, physics, and chemistry the rates of growth in doctoral research staff during the 1973-77 period significantly exceeded the postdoctoral growth rates. In physics, in fact, the numbers of assistant professors, instructors, and postdoctorals have declined since 1973. In many other fields there has been considerable expansion in the postdoctoral category. In every field except psychology the total nonfaculty growth surpassed faculty growth during this four-year period (in psychology faculty and nonfaculty expansion were approximately equivalent).

Figure 2 displays the percentages of scientists and engineers employed in academia in 1977 who held one of the three categories of nonfaculty appointments. In physics the doctoral research staff and postdoctoral groups each represented more than 7 percent of the total academic personnel. The chemistry and bioscience postdoctorals constituted 10 percent and 11 percent of the academic populations, respectively. In mathematics, psychology, and the social sciences, on the other hand, the nonfaculty staff who were not engaged

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[37]Tables describing 1977 FFRDC research staff are presented in Appendix G.

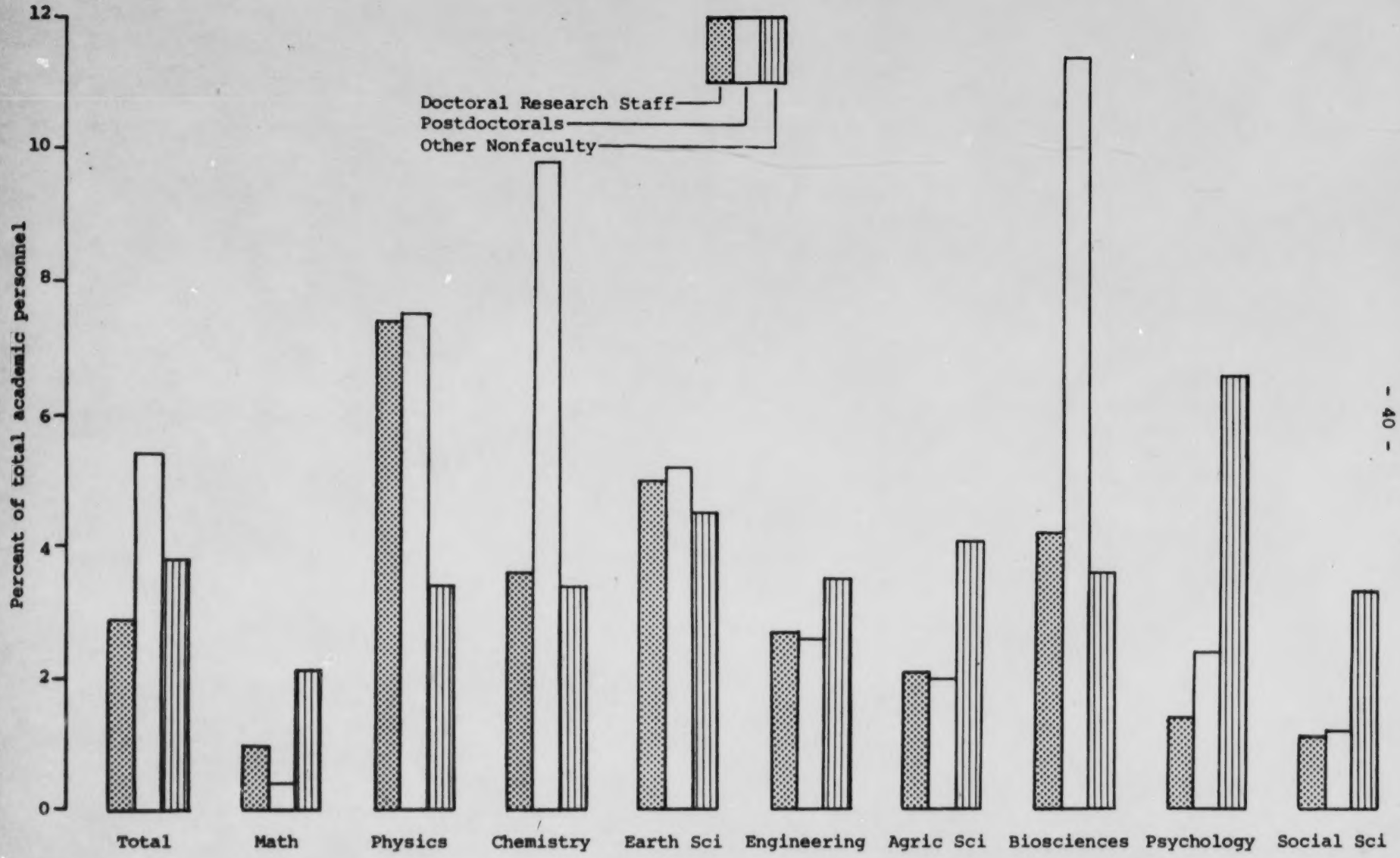

FIGURE 2 Percent of academic personnel holding nonfaculty staff positions in science and engineering, 1977. Percentages have been calculated from data reported in Table 15.

in research as a principal activity outnumbered the postdoctorals and doctoral research staff.

The tables that follow describe recent changes in the demographic characteristics and employment situations of doctoral research staff in each science and engineering field. As in the previous chapter, a brief synopsis of the findings has been provided with each table, but a more detailed analysis has been left to the reader. Once again, the reader is cautioned that some of the data reported for the doctoral research staff groups are based on small numbers of survey responses.[38]

[38]Estimated sampling errors for data present in this chapter are given in Appendix D.

Trends in Full-Time Academic Research Personnel

Although doctoral research staff represented only 5 percent of all Ph.D. scientists and engineers employed in academia in 1977, these staff members constituted more than 10 percent of the full-time academicians engaged in research.[39] The doctoral research staff in physics constituted 18 percent of the academic research group in 1973 and 22 percent in 1977. In other fields--agricultural sciences, psychology, and social sciences, especially--the doctoral research staff represented a much smaller fraction of the total research group. In chemistry the number of full-time faculty primarily engaged in research has increased considerably during this four-year period.

TABLE 16 TRENDS IN EMPLOYMENT POSITIONS OF FULL-TIME ACADEMIC STAFF PRIMARILY ENGAGED IN RESEARCH IN SCIENCE AND ENGINEERING, 1973 TO 1977

	EST TOTAL N	ITEM RESP n	POSITION FACULTY %	RSRCH STAFF %	POST DOCS %
TOTAL ALL FIELDS					
1973	26724	4284	72.3	9.9	17.7
1975	29871	4584	70.9	10.3	18.9
1977	36405	5044	71.1	10.2	18.7
MATHEMATICS					
1973	1615	249	91.9	4.3	3.8
1975	1582	222	88.0	7.5	4.6
1977	1995	267	88.2	9.1	2.7
PHYSICS					
1973	2319	325	52.0	17.9	30.2
1975	2461	346	54.3	20.8	24.9
1977	2929	369	55.5	22.0	22.5
CHEMISTRY					
1973	2055	306	44.1	9.5	46.4
1975	2724	407	52.3	7.7	40.0
1977	3603	517	55.1	11.5	33.4
EARTH SCIENCES					
1973	1129	165	68.2	18.1	13.7
1975	1290	177	64.1	21.5	14.4
1977	1497	197	65.5	17.4	17.2
ENGINEERING					
1973	1792	205	75.8	13.9	10.3
1975	2006	211	77.1	16.5	6.4
1977	2620	246	76.2	12.3	11.5
AGRICULTURAL SCI					
1973	2744	389	92.7	4.8	2.4
1975	3384	452	92.6	3.2	4.2
1977	3152	374	90.1	5.0	4.9
BIOSCIENCES					
1973	11074	2111	69.1	9.3	21.6
1975	12143	2236	66.3	9.0	24.7
1977	14786	2447	66.2	8.9	24.9
PSYCHOLOGY					
1973	1867	257	80.7	11.9	7.4
1975	1820	234	74.6	11.2	14.2
1977	2183	268	82.2	7.6	10.2
SOCIAL SCIENCES					
1973	2129	277	89.7	6.0	4.3
1975	2461	299	85.7	8.6	5.7
1977	3640	359	85.4	7.2	7.4

SOURCE: NRC, Survey of Doctorate Recipients, 1973, 1975, 1977.

[39] Included in this group are all scientists and engineers who were employed full-time in the academic sector (including those in postdoctoral training) and who regarded research to be their primary work activity.

Trends in Institution of Employment

In recent years the numbers of doctoral research staff employed in colleges and universities which did not have doctoral programs has increased significantly. In 1973 less than 2 percent (an estimated 45 scientists and engineers) of the doctoral research staff were employed in non-Ph.D.-granting institutions; in 1977 approximately 8 percent (an estimated 346 individuals) of the research staff worked in these schools. It must be noted, however, that the number of doctoral research staff employed in Ph.D.-granting universities also increased during this four-year period (from an estimated 2,293 scientists and engineers in 1973 to 2,889 in 1977).

TABLE 17 TRENDS IN EMPLOYMENT INSTITUTIONS OF DOCTORAL RESEARCH STAFF IN SCIENCE AND ENGINEERING, 1973 TO 1977

	EST TOTAL N	ITEM RESP n	PH.D. GRANTING UNIV %	MED SCHL %	OTHER UNIV/ COLL %
TOTAL ALL FIELDS					
1973	3033	505	75.6	22.9	1.5
1975	3468	546	70.0	24.8	5.2
1977	4163	607	69.4	22.3	8.3
MATHEMATICS					
1973	76	12	66.7	33.3	
1975	123	16	91.1	6.5	2.4
1977	188	30	70.7	6.9	22.3
PHYSICS					
1973	445	65	100.0		
1975	543	76	97.8		2.2
1977	673	81	93.5	1.8	4.8
CHEMISTRY					
1973	226	36	87.6	12.4	
1975	241	39	70.1	26.1	3.7
1977	449	63	75.9	12.7	11.4
EARTH SCIENCES					
1973	237	43	97.2	.5	2.3
1975	296	43	85.5		14.5
1977	276	41	92.8	1.1	6.2
ENGINEERING					
1973	263	28	93.9	6.1	
1975	356	35	92.4	5.6	2.0
1977	358	38	83.8	2.8	13.4
AGRICULTURAL SCI					
1973	150	19	90.2		9.8
1975	128	20	100.0		
1977	166	23	86.1		13.9
BIOSCIENCES					
1973	1185	235	52.4	46.6	1.0
1975	1276	244	49.2	48.6	2.2
1977	1521	267	45.6	49.2	5.1
PSYCHOLOGY					
1973	297	44	71.1	23.3	5.6
1975	280	44	47.1	50.4	2.5
1977	221	35	76.5	19.5	4.1
SOCIAL SCIENCES					
1973	154	23	100.0		
1975	225	29	64.9	4.0	31.1
1977	311	29	72.0	12.9	15.1

SOURCE: NRC, Survey of Doctorate Recipients, 1973, 1975, 1977.

Trends in Federal Support

The fraction of doctoral research staff who received federal support declined slightly during the 1973-77 period; the estimated numbers of federally supported staff members increased from 2,584 in 1973 to 3,451 in 1977. Throughout this period the National Institutes of Health (NIH) and the National Science Foundation (NSF) together provided support for more than half of the doctoral research staff scientists and engineers. The NIH funding has been concentrated in chemistry and psychology, as well as in the biosciences. The NSF funding has been primarily in the physical sciences and engineering. During this four-year period the National Aeronautics and Space Administration supported between 8 and 10 percent of the doctoral research staff, almost exclusively in the physical sciences and engineering.

TABLE 18 TRENDS IN FEDERAL SOURCES OF SUPPORT FOR DOCTORAL RESEARCH STAFF, 1973 TO 1977

					SUPPORTING AGENCY							
TOTAL ALL FIELDS	EST TOTAL N	ITEM RESP n	NO FEDL SUPT %	SOME FEDL SUPT %	DOA %	DOD %	EPA %	AEC/ ERDA %	NASA %	NIH %	NSF %	OTHERS %
1973	3033	536	14.8	85.2	6.2	13.8	2.5	6.4	8.1	31.1	24.2	14.4
1975	3468	542	20.7	79.3	3.7	9.0	1.6	6.6	10.4	29.9	22.8	13.2
1977	4163	589	17.1	82.9	3.1	9.0	2.1	11.5	9.0	33.4	22.6	12.1
MATHEMATICS												
1973	76	13	11.7	88.3	15.6	7.8		3.9	2.6	32.5	23.4	7.8
1975	123	16	42.1	57.9		18.2			16.5	8.3	16.5	
1977	188	30	51.6	48.4		21.8		1.1	3.7	6.9	15.4	6.4
PHYSICS												
1973	445	65	5.4	94.6		40.8	4.6	16.3	28.0		33.2	5.0
1975	543	76	5.3	94.7		12.8		24.8	30.7	1.8	42.7	5.5
1977	673	79	7.7	92.3		13.4		37.1	31.2	3.4	32.0	.8
CHEMISTRY												
1973	226	38	20.7	79.3	2.3	4.1	1.4	8.6	7.7	41.0	29.7	5.4
1975	241	40	22.6	77.4	4.4	2.4		11.5	9.5	36.1	22.2	7.1
1977	449	61	14.6	85.4	4.9	7.7		13.9	10.4	27.8	30.2	8.4
EARTH SCIENCES												
1973	237	44	10.1	89.9		17.3	8.0	4.2	24.1		56.5	30.0
1975	296	43	11.4	88.6	2.6	18.0	3.3	7.5	24.5	2.0	51.6	25.8
1977	276	41	17.0	83.0		29.7	3.3	10.5	12.0	3.6	44.9	23.6
ENGINEERING												
1973	263	30	4.3	95.7	3.6	31.9	6.5	10.5	8.3	10.9	27.9	20.3
1975	356	34	23.7	76.3		25.7	5.6	3.1	19.2	9.0	19.2	9.0
1977	358	38	15.9	84.1		25.1	5.9	27.1	15.1	3.9	32.1	13.7
AGRICULTURAL SCI												
1973	150	25	31.4	68.6	43.6			3.2		4.5	8.3	13.5
1975	121	20	29.0	71.0	49.6			3.8			4.6	13.0
1977	166	22	37.9	62.1	47.2			3.7			11.2	
BIOSCIENCES												
1973	1185	245	15.9	84.1	5.9	5.7	1.0	5.0	1.8	57.6	19.7	5.8
1975	1276	241	17.2	82.8	2.5	3.0	1.5	2.0	.6	60.7	14.9	14.6
1977	1521	257	14.3	85.7	1.8	.7	2.2	1.8	1.4	71.4	15.0	8.3
PSYCHOLOGY												
1973	297	52	12.3	87.7	4.3	5.2			.9	37.2	12.3	36.9
1975	280	44	31.6	68.4	4.6	6.4				36.2	12.4	13.5
1977	221	33	19.2	80.8		9.1	5.3			41.3	5.8	37.0
SOCIAL SCIENCES												
1973	154	24	40.2	59.8	9.1	6.7	3.0			3.7	10.4	42.7
1975	225	28	52.9	47.1		6.2	2.7			11.6	12.9	26.7
1977	311	28	22.2	77.8			4.0			12.5	19.2	42.1

SOURCE: NRC, Survey of Doctorate Recipients, 1973, 1975, 1977.

Trends in Demographic Characteristics

Data below indicate a significant decrease in the number of recent Ph.D. recipients who have taken nonfaculty research staff appointments. In 1973 an estimated 977 scientists and engineers (nearly one-third) of the doctoral research staff had earned their Ph.D. degrees within the prior two years. In 1977 only an estimated 741 individuals (18 percent) had been awarded their doctorates within the last two years. During this same period the numbers of research staff who had earned Ph.D. degrees five to eight years earlier more than doubled. These cohorts included an estimated 651 (18.5 percent) of the 1973 staff members, and an estimated 1,353 (32.5 percent) of the 1977 staff.

TABLE 19 TRENDS IN YEARS SINCE AWARD OF DOCTORATE OF DOCTORAL RESEARCH STAFF, 1973 TO 1977

	EST TOTAL N	ITEM RESP n	YEARS SINCE PH.D. 1-2 %	3-4 %	5-6 %	7-8 %	9-10 %	>10 %
TOTAL ALL FIELDS								
1973	3033	550	32.2	21.3	10.6	7.9	5.7	22.4
1975	3468	546	25.4	19.4	14.4	11.0	7.4	22.4
1977	4163	607	17.8	20.0	20.1	12.4	6.8	22.8
MATHEMATICS								
1973	76	13	47.4	25.0		1.3	6.6	19.7
1975	123	16	43.1	17.1	14.6	7.3	12.2	5.7
1977	188	30	34.6	20.7	5.3	6.9	5.3	27.1
PHYSICS								
1973	445	66	38.0	19.3	14.4	11.2	4.0	13.0
1975	543	76	20.3	17.1	18.4	13.1	6.8	24.3
1977	673	81	10.4	21.7	24.1	19.8	5.9	18.1
CHEMISTRY								
1973	226	39	48.7	21.2	9.7	4.0	8.8	7.5
1975	241	39	20.3	17.4	22.0	6.2	7.5	26.6
1977	449	63	25.4	28.1	15.6	6.0	4.5	20.5
EARTH SCIENCES								
1973	237	46	47.7	11.4	10.1	4.6	1.3	24.9
1975	296	43	26.7	27.0	12.5	13.9	2.4	17.6
1977	276	41	11.2	29.7	26.1	8.3	10.5	14.1
ENGINEERING								
1973	263	30	31.2	26.6	11.4	19.0		11.8
1975	356	35	35.1	18.5	8.7	10.4	14.3	12.9
1977	358	38	20.9	11.2	19.3	3.6	12.3	32.7
AGRICULTURAL SCI								
1973	150	26	18.0	16.0		6.0	18.7	41.3
1975	128	20	22.7	9.4	13.3	10.9		43.8
1977	166	23	10.8	24.7	30.7		2.4	31.3
BIOSCIENCES								
1973	1185	253	28.3	22.3	11.4	6.2	5.8	26.1
1975	1276	244	20.2	21.7	14.4	12.5	6.4	24.7
1977	1521	267	17.9	15.6	21.7	15.4	6.2	23.2
PSYCHOLOGY								
1973	297	52	23.9	28.3	12.8	8.8	3.4	22.9
1975	280	44	38.2	11.1	14.3	8.9	5.0	22.5
1977	221	35	2.7	19.9	13.1	22.6	15.8	25.8
SOCIAL SCIENCES								
1973	154	25	22.1	14.9	5.8	6.5	12.3	38.3
1975	225	29	31.1	22.7	8.4	3.6	15.1	19.1
1977	311	29	28.9	24.1	14.5	8.0	2.9	21.5

SOURCE: NRC, Survey of Doctorate Recipients, 1973, 1975, 1977 and Survey of Earned Doctorates, 1958-1976.

Trends in Demographic Characteristics (cont.)

During the 1973-77 period the rates of increase in the number of women and the number of men holding doctoral research staff appointments have been roughly comparable. In 1973 an estimated 692 women were employed as doctoral research staff--approximately 23 percent of the total staff. In 1977 an estimated 849 women (20 percent of the total group) held this type of academic appointment. Similarly, there has been little change in the fraction of research staff who were of foreign origin.

TABLE 20 TRENDS IN SEX AND COUNTRY OF ORIGIN OF DOCTORAL RESEARCH STAFF, 1973 TO 1977

	SEX				ORIGIN			
	EST TOTAL	ITEM RESP	MALE	FEML	EST TOTAL	ITEM RESP	U.S.	FRGN
TOTAL ALL FIELDS	N	n	%	%	N	n	%	%
1973	3033	550	77.2	22.8	3030	541	82.7	17.3
1975	3468	546	80.6	19.4	3468	543	83.6	16.4
1977	4163	607	79.6	20.4	4163	602	82.1	17.9
MATHEMATICS								
1973	76	13	88.2	11.8	76	13	85.5	14.5
1975	123	16	96.7	3.3	123	16	95.9	4.1
1977	188	30	86.2	13.8	188	30	83.5	16.5
PHYSICS								
1973	445	66	93.0	7.0	445	65	78.3	21.7
1975	543	76	94.3	5.7	543	76	84.5	15.5
1977	673	81	97.2	2.8	673	81	86.5	13.5
CHEMISTRY								
1973	226	39	85.4	14.6	226	39	80.5	19.5
1975	241	39	90.0	10.0	241	39	75.5	24.5
1977	449	63	86.4	13.6	449	63	77.1	22.9
EARTH SCIENCES								
1973	237	46	86.5	13.5	237	45	84.3	15.7
1975	296	43	93.9	6.1	296	43	87.8	12.2
1977	276	41	87.7	12.3	276	41	81.5	18.5
ENGINEERING								
1973	263	30	100.0		263	30	80.6	19.4
1975	356	35	99.4	.6	356	35	76.7	23.3
1977	358	38	96.9	3.1	358	37	71.8	28.2
AGRICULTURAL SCI								
1973	150	26	88.0	12.0	150	25	79.9	20.1
1975	128	20	95.3	4.7	128	19	69.7	30.3
1977	166	23	89.8	10.2	166	23	69.9	30.1
BIOSCIENCES								
1973	1185	253	65.3	34.7	1185	249	80.8	19.2
1975	1276	244	67.1	32.9	1276	242	82.4	17.6
1977	1521	267	68.7	31.3	1521	263	79.8	20.2
PSYCHOLOGY								
1973	297	52	63.6	36.4	297	52	91.9	8.1
1975	280	44	60.4	39.6	280	44	95.7	4.3
1977	221	35	45.2	54.8	221	35	98.2	1.8
SOCIAL SCIENCES								
1973	154	25	67.5	32.5	154	23	98.6	1.4
1975	225	29	75.1	24.9	225	29	88.4	11.6
1977	311	29	72.7	27.3	311	29	96.8	3.2

SOURCE: NRC, Survey of Doctorate Recipients, 1973, 1975, 1977 and Survey of Earned Doctorates, 1958-1976.

V. IMPLICATIONS OF THE CHANGING ROLE OF DOCTORAL RESEARCH STAFF IN ACADEMIC RESEARCH

The preceding two chapters provide a description of the demographic characteristics and employment situations of doctoral research staff, based on national survey data. This final chapter considers the changing role of this group in academic research and the implications of this change. Much of the discussion is based on insights obtained from a one-day conference[40] convened by the Committee. Participants in the conference included federal administrators as well as university deans and faculty, and provided a broad perspective of the academic research enterprise. The conference discussion focussed on five general topics: (1) the implications of expected increases in the total number of doctoral research staff; (2) the contributions of this group to programs of research; (3) the university status of doctoral research staff; (4) the career prospects for members of this group; and (5) the possible need for further studies for federal and university policy-makers. This chapter considers each of these topics. Information from the conference supplemented by that provided by university deans and department chairmen[41] is used throughout the chapter to document various points of view relevant to these topics.

Expected Increases in Doctoral Research Staff

Fifteen years ago Clark Kerr, President of the University of California, wrote:

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[40] A list of participants is included in Appendix C, along with the agenda.

[41] A copy of the Committee's letter requesting information on doctoral research staff and postdoctorals and a list of recipients of the letter are included in Appendix A.

> University scholars traditionally have both taught and conducted research. But now some scholars are added to the staff in exclusively research capacities . . . . They have no teaching responsibilities and are not yet fully accepted member of the Academic Senate and they usually are not given tenure--both traditional marks of faculty status . . . . The 'faculty' in our universities becomes an ever-changing group as the definitions change. If there can still be said to be a 'faculty' at all, it is almost certainly a different composite than before. Much of the teaching, much of the research are done by the 'unfaculty.'[42]

In recent years changing circumstances have reinforced the tendency of universities to enlist the assistance of professional (nonfaculty, non-student) research staff.

Several major factors have contributed to the significant increases in the numbers of nonfaculty research staff. Perhaps the most important factor has been the continuing growth over the past 15 years or so in what is sometimes called "big science." The large, complex research projects, which often include designing, building, and maintaining large equipment, require long-term staff with specialized skills who can devote their full-time energies to specific tasks. Neither faculty with teaching responsibilities nor postdoctorals on temporary appointments are as ideally suited to fill this role as are doctoral research staff. Another factor has been the decline in graduate enrollment in many science and engineering fields which has meant that fewer graduate students are available to assist on research projects. In physics, chemistry, and mathematics, for example, full-time graduate enrollments peaked in the late 1960's.[43] Smith and Karlesky, in their recent study of graduate programs in 36 universities, found that declining graduate enrollments were spurring deparments to "substitute research technicians, support personnel, or

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[42]Clark Kerr, The Uses of the University (Harvard University Press, Cambridge, Massachusetts, 1964), pp. 65-7.

[43]David W. Breneman, in The State of Academic Sciences: Background Papers (Change Magazine Press, New York, 1978), pp. 134, 139-41.

postdoctorals for graduate students."[44] Finally, the lack of growth in undergraduate enrollments as well has resulted in fewer faculty openings for young scientists and engineers. In 602 departments surveyed by the National Science Foundation, the number of faculty members who had earned doctorates within the past seven years dropped 24 percent between 1968 and 1974.[45] As a result, the doctoral research staff appointment may be the only position available for many scientists and engineers interested in pursuing a career in academic research. Thus, the chairman of a department of biological sciences concluded: "Given the new realities of a shrinking student population and limitations on tenure stream appointments, an adequate research effort in the country will demand a growth in doctoral research staff."[46]

Other factors, however, are expected to limit future increases in the number of nonfaculty investigators. While some university departments would like to employ more doctoral research staff, their numbers are not likely to grow very fast as long as federal support of university research grows as slowly as it has in recent years. What increases do occur may be primarily among those doctoral research staff involved with large research efforts and not those serving as principal or coinvestigators. As one federal administrator who participated in the conference emphasized, because of the high cost of instrumentation, some federal agencies are "not paying the young investigators in order to save the large research centers." Furthermore, some university officials may be hesitant to hire large numbers of doctoral research staff. A department chairman at a major university noted:

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[44]Smith and Karlesky, op. cit., p. 236.

[45]National Science Foundation, Young and Senior Science Engineering Faculty, 1974 (Government Printing Office, Washington, D.C., 1975), p. 2.

[46]From a response to the Committee's letter in Appendix A.

> Our faculty is severely divided on the advisability of having significant numbers of such persons (doctoral research staff) on our staff. The pressures for such persons to be granted principal investigatorships is great; the gradual acquisition of a feeling that the institution owes the persons something after increasing years of service is very common; and feelings of moral obligation on the part of the faculty toward such persons all are negative results from having even higher quality doctoral research staff persons in a department.[47]

Contributions to Programs of Research

The roles that doctoral research staff members play in programs of research may vary considerably. Some fill a service role, performing such functions as analyzing data, writing computer programs, and operating specialized equipment. Others serve as principal investigators. A policy statement from Yale University identifies two classes of research staff:

> To carry on the complex activities of modern research, the efforts of students and teaching faculty are amplified by the cooperation of highly selected research appointees and a professional technical staff. Though the distinction is not always clear cut, the professional staff is primarily composed of persons who contribute sophisticated services essential to the performance of research, but do not themselves perform research. The research appointees are persons actively engaged in research, who normally have an M.D. or Ph.D. degree or the equivalent experience and whose contribution is of a level meriting coauthorship of the published results of the endeavor.[48]

In many fields of research the process of investigation requires the concerted effort of a much larger workforce than a traditionally constituted academic department can muster from among its faculty and students. Principal investigators have met the challenge by forming more-or-less independent research groups composed of the talent they need. One particularly large

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[47] Ibid.

[48] "Policy and Procedures for Postdoctoral Research Appointments," Office of the Provost, Yale University, December 12, 1973.

group which has been studied as a case in point is the group which Professor Luis Alvarez formed around him at the Lawrence Radiation Laboratory in the 1950's and 1960's to do high-energy bubble chamber research. Beginning with two graduate students in 1952, the group came to include 20 graduate students, 23 Ph.D. staff, and 160 to 170 auxiliary technical and administrative personnel by the mid-1960's.[49] The research activities in which they were engaged divided into six distinct steps: instrument development, experiment choice, data collection, data reduction, data interpretation, and publication.[50] Many other areas of research also require large teams of investigators. In space research, for example, there is the same need to design highly sophisticated equipment. The instruments on a space craft send back more information than any individual can analyze alone. The vehicle may take months to reach its destination, longer than a graduate student or a junior faculty member who is anxious about tenure can wait. Oceanography, too, involves complex equipment, long voyages, and massive data collection. Longitudinal and large population studies in clinical research, psychology, and sociology often require data collection by many observers over long periods of time and massive data analysis. Doctoral research staff members provide both the continuity and specialized skills needed on research teams in these and other areas.

From the preliminary information the Committee has gathered, it is quite apparent that the utilization of research staff varies considerably among the fields of science and engineering. A recent study[51] of 619 departments in

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[49]Gerald M. Swatez, "The Social Organization of a University Laboratory," Minerva, Vol. III, No. 1 (January 1970), p. 40.

[50]Ibid., pp. 45, 48.

[51]Gomberg and Atelsek, op. cit., pp.. 11, 21.

seven disciplines relevant to biomedical research illustrates this point. The study found significant variation in the average number of nontenure-track personnel in the departments within each discipline:

	Total depts.	Nontenure-track personnel	Average per dept.
Biochemistry	110	700	6.4
Biology	112	600	5.4
Chemistry	141	1,000	7.1
Genetics	25	100	4.0
Medicine	49	2,100	42.9
Microbiology	103	400	3.9
Pharmacology	79	400	5.1

The average number of such personnel in a department ranged from approximately 4 in microbiology to more than 40 in departments of medicine (the latter departments often have many more tenure track personnel as well). These estimates include M.D. as well as Ph.D. recipients and consequently cannot be compared with data presented in the preceding chapters.

Many of the doctoral research staff are employed in large university laboratories which are not under department control, but report to the university administration through other channels. At M.I.T. in 1976, for example, there were 24 laboratories and research centers outside the department structure. Of the Institute's 1,046 nonfaculty research staff appointees, nearly half were in these 24 laboratories:[52]

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[52]Massachusetts Institute of Technology, "Report of the Committee on M.I.T. Research Structure" (October 1976), Attachment 1.

	In departments	In laboratories and centers outside departmental structure
Senior research scientists, senior research associates, postdoctoral fellows, research associates	376	92
Other full-time professional research staff (including doctoral staff as well as others)	152	426

The establishment of laboratories outside the department may be attributed to a combination of faculty initiative and federal sponsorship. Some university laboratories which started as extensions of faculty research have grown so large in the service of government, and have evolved so far from the usual academic structure, that they have been split off to continue on their own. The staff in these and other federally funded research and development centers are not counted in the doctoral research group in this report.

The importance of doctoral research staff to programs of research depends, to a great extent, on the nature of the research effort. The chairman of a behavioral science department which was heavily engaged in research told the Committee:

> The research program of the (department) could not be carried on without the use of doctoral research staff. Meeting the needs of a long-term longitudinal research program requires not only staff continuity but a substantial number of well-trained (i.e., doctoral) behavioral scientists who can spend at least half of their time at research. It is simply not feasible to secure the kind of staff needed through academic appointments to regular departments, though a number of senior and junior faculty are involved part-time in this enterprise. Few of the postdocs at (this department) contribute as much to the research program as do those who are employed on the doctoral research staff and in some respects, at least, postdoctoral fellowships have simply become a

> source of support for persons who have shown a little promise but who are not really first-rate researchers . . . . Also since their research skills are often far more sophisticated than those of the postdoctorals, they (doctoral research staff) can bring to bear a level of expertise not only beyond that of the postdoctorals but often beyond that of most available faculty members.[53]

Other department chairmen and deans pointed out that the flexibility and continuity provided by doctoral research staff may become increasingly important as research grows. On the other hand, some chairmen thought less of the research contribution of this group. A biological sciences department head commented:

> The contribution of the doctoral research staff to the initiation of experimental approaches is probably less significant (compared with postdoctorals) by virtue of the fact that they must, perforce, be the remainder of a group from which the brightest and most abitious have been selected for tenure stream appointments.[54]

As noted by one university administrator who participated in the conference, in the future it may be more appropriate to think of the doctoral research staff as "indians" rather than "chiefs."

Status in the University

An M.I.T. committee chaired by Frank Press examined the standing of nonfaculty research staff within the Institute in 1976 and summarized the status of this group as follows:

> The intellectual quality of the nonfaculty research staff could be just as high as that expected of the faculty, yet the culture of the academic community often seems to give such full-time staff the feeling that they are viewed as second-class members of the

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[53] From a response to the Committee's letter in Appendix A.

[54] Ibid.

> community. In fact, the differences in conditions of employment, voting rights, and similar attributes of the job tend to bear out that view.[55]

On many campuses the nonfaculty research staff are not given voting privileges and are excluded from serving on doctoral committees. In some institutions these staff members may not even participate in the university pension program. Furthermore, doctoral research staff members do not hold tenure and often receive short notice of their terminations.

The group acquired its anomalous place in the university from the manner in which most university research is funded. The funds come from outside the university and are provided, not to the university as a whole, but for individual investigators and individual projects. While the research staff members are formally university employees, their real employer is the investigator or research group recruiting them and paying their salary.

Even the identification of doctoral research staff in the universities may be difficult. While the present study is concerned particularly with research staff holding Ph.D. (or equivalent research doctorate) degrees, university appointment structures normally do not distinguish between doctorate level staff and other nonfaculty researchers. At the University of Wisconsin at Madison, for example, the doctoral research staff appointments are classified as "academic staff"[56] along with a variety of other positions including librarians, dormitory administrators, etc. Furthermore, in many situations it may not be possible to distinguish doctoral research staff from postdoctoral appointees. Often both groups carry the title of "research associate." Individuals may confuse the issue when they start as postdoctorals, ostensibly on temporary

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[55] Massachusetts Institute of Technology, op. cit., p. 58.

[56] From a response to the Committee's letter in Appendix A and discussions at the conference described in Appendix C.

appointments, and become fixtures. If postdoctorals supported on a research grant continue in their appointments for more than three years, it may make sense to consider them permanent research staff members rather than postdoctoral trainees. The only feature that may still single them out as postdoctorals is their low stipend.

To the extent an institution is prepared to give a teaching title (instructor, assistant professor, etc.) to a researcher supported entirely on "soft" money, the doctoral research staff merge with faculty. In the preceding chapters any university researcher with a faculty title has been ipso facto excluded from the doctoral research staff population, although in all other respects (source of salary, primary work activity, etc.) he or she may be indistinguishable from research staff members. While few graduate schools are prepared to give a teaching title to a researcher paid entirely out of "soft" money, a considerable number of medical and other professional schools do so.[57] At one large medical school, in fact, as many as three-fourths of the "faculty" are supported primarily by research grants and contracts.

An important aspect of a young scientist's standing in the university is whether or not he or she is permitted to apply for research support as a principal investigator. A recent survey of biomedical-related departments found that less than half of these staff members were eligible to apply for federal support as principal investigators and less than 10 percent had actually received support in 1976-77 as principal investigators.[58] The reasons most frequently given for discouraging nontenure-track personnel from

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[57]This conclusion is based on information provided by deans and department chairmen in writing and in site visits.

[58]Atelsek and Gomberg, op. cit., Table 3, p. 11.

applying for their own support were (1) that they are hired for specific services and (2) that limited lab space and equipment are available.[59]

Several participants at the conference called by the Committee expressed concern that policies discouraging nonfaculty staff members from applying for research support might contribute to reducing their imagination and inventiveness as investigators. As one participant put it: "It might beat the enterprise out of them." The contrast was made between the situation ten years ago when most young Ph.D. recipients or postdoctoral appointees went straight to assistant professorships, in which they were under immediate pressure to demonstrate their creativity, and the situation today when many young investigators who would like to remain in basic research can only find nonfaculty research staff positions. If few can serve as principal investigators, what effect will this change have on the creativity of young scientists and engineers? One conference participant noted that many positions in industry offered more scope for creativity than doctoral research staff appointments.

As a result of the growing numbers of doctoral research staff on university campuses, some universities have already established personnel guidelines which take into account the rights and privileges of this group. One department chairman commented:

> If the doctoral research staff appointments burgeon . . . it will be vital for departments to establish guidelines and procedures for appointment and termination of appointment of the doctoral staff that are as detailed and objective as for tenure-stream appointments. As a matter of fact, a procedure of this kind has been formulated in my own department and is just in the process of receiving departmental approval. It will also be necessary for the

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[59] Ibid., Table 13, p. 21.

> funding agencies to take account of the new economic reality and to make funding arrangements which encourage and protect these relationships.[60]

The guidelines adopted by departments and universities vary considerably and will not be summarized here. The need for more institutions to develop university-wide personnel regulations which take into account doctoral research staff was strongly emphasized by the conference participants. As one participant put it: "This group may become a source of embarrassment if not awarded proper status." The need for flexibility in these regulations in order to take into account the different circumstances under which research staff appointments are made was also emphasized. In fact, the diversity of these appointments from one department to another has been a major obstacle in establishing a set of institutional guidelines for many universities. Future overregulation of these appointments might result in fewer doctoral research staff being hired.

Career Prospects

In recognition of the need for new career opportunities for young scientists and engineers, some universities have already established formal career tracks for nonfaculty researchers, comparable to the tenure track system for faculty. At M.I.T., for example, four ranks of professional staff research appointments have been created:[61] (1) research specialist/technical assistant; (2) research scientist/research engineer/research associate; (3) principal research scientist/principal research engineer/principal research associate; and (4) senior research scientist/senior

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[60] From a response to the Committee's letter in Appendix A.

[61] For more details see "Campus Research Staff Appointment Structure (Office of the Vice President Administration and Personnel, Massachusetts Institute of Technology).

research engineer/senior research associate. Each rank has its associated responsibilities, qualifications, benefits, and privileges. In recommending this career track, the faculty committee noted:

> The concept of full-time professional careers, independent of classroom teaching and supported entirely from research grants, is not a new one for the American research university. These positions exist under various names and job descriptions. The Committee feels that this mode of research involving full-time professionals working in departments and campus laboratories and centers offers an important, if not the major mechanism, for universities to maintain research viability, enter new fields, bring young researchers to the campus, and in this way compensate for the lack of faculty positions, the diminishing teaching function, and the leveling of endowments. We shall always need full-time research staff. However, these positions are of particular importance over the next decade because of the age distribution of the faculty.[62]

Some conference participants expressed concern about the long-range career prospects for those taking doctoral research staff appointments. Many important questions have been raised which cannot be fully answered on the basis of existing information:

(1) Will the research appointment be a "second order holding pattern" for postdoctorals and those faculty unsuccessful in acquiring tenure?

(2) Will a series of these appointments represent a viable career for some scientists and engineers?

(3) To what extent will those holding research appointments be able to move into faculty positions either within the same university or in other institutions?

(4) What other employment opportunities will be available to young scientists and engineers holding doctoral research staff apointments?

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[62]Massachusetts Institute of Technology, op. cit., p. 92.

(5) Will the research appointment generally be considered a "second class" position by most young scientists and engineers? If so, what effect will this have on the productivity of the individual and the research program?

The answers to these questions will depend, in part, on the type of position held by the research staff member. The career prospects are likely to be more promising for those who are given an opportunity to serve as principal or co-investigator in the research effort and those who will be recognized as lead authors in the published results. From the information now available it is not possible to determine how many of the doctoral research staff members hold this type of appointment and how many serve in a more limited capacity as "research assistants."

To the extent that doctoral research staff positions discourage initiative in research, it has been suggested that this impact falls especially hard on women scientists. As shown earlier[63] the proportions of women holding these positions in the biosciences, psychology, and the social sciences were quite large (significantly greater, in fact, than the proportions of women earning doctorates in these fields in recent years), and many of them were employed less than full-time. Furthermore, a 1973 survey[64] which compared the occupational record of matched samples of men and women Ph.D. recipients who graduated between 1950 and 1969 found that among those working at colleges and universities the proportion of women holding a research appointment without faculty status was six times higher than among men (3.9 percent compared with 0.6 percent). The reasons for these large differences in the employment

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[63]See Tables 5 and 9 in Chapter III.

[64]John A. Centra, Women, Men, and the Doctorate (Educational Testing Service, Princeton, New Jersey, 1974), p. 58.

situations of men and women are not fully understood. Whether or not job discrimination is a factor, however, the position of the woman research staff member is a cause for concern if the conditions of her employment inhibit her from achieving her full potential as a scientist.

Need for Further Study

On the basis of its preliminary investigations the Committee has concluded that the changing role of doctoral research staff is an important issue that requires continuing attention by federal and university policy-makers. As one conference participant put it, "One conclusion can be drawn from the meeting: funding agencies and universities should be aware of this growing problem and should seek ways to ameliorate the less desirable aspects." In many respects the doctoral research staff resemble the postdoctoral population in the late 1960's--a group increasingly important to academic research and yet still "invisible." The information presented in the preceding chapters on the characteristics and employment situations of doctoral research staff and the growth trends of this group leave many questions unanswered. For example, little is known about the responsibilities and motivations of this group--how many initiate and conduct their own research, how many provide specialized skills to large research teams, how many serve as "hired hands" because more desirable employment opportunities were not available, etc.

In order to obtain a sound basis for making policy recommendations concerning doctoral research staff, more information will be required from young scientists and engineers interested in careers in academic research as well as from their current and prospective employers (department chairmen and mentors). The suggestions that follow were made at the conference. While surveys covering all fields of science and engineering are needed because of the

considerable diversity among different areas of research, more detailed studies--for example, site visits to selected departments in a particular field--will also be important. A conference of university deans to exchange ideas on existing personnel practices would be useful in providing academic policy-makers with alternative sets of regulations that they might consider adopting for their own institutions.

Future studies of the doctoral research staff population should recognize two quite different aspects of this issue: the need to maintain a productive research enterprise in universities and in the country as a whole; and the need to provide worthwhile career opportunities for promising young scientists and engineers. In this regard several questions stand out:

(1) How should universities accommodate nontenure-track research staff in their appointment structure?

(2) Are there aspects of the research staff appointment which should be modified to encourage the creativity of staff members?

(3) Can granting agencies contribute to improving the conditions of employment of research staff?

(4) What alternative means are there for maintaining the quality and productivity of research, other than increases in the number of doctoral research staff?

The pressing need for further study to answer these and other policy questions has been recognized by both the members of the Committee and those who participated in the conference. As one participant put it, "We are examining an important issue before it reaches a crisis stage. We now know the next steps to take. It (the conference) was worthwhile."

APPENDIXES

LIST OF APPENDIXES

		PAGE
APPENDIX A	Committee Letter Sent to University Deans/ Department Chairmen and List of Recipients	1
APPENDIX B	List of Institutions and Departments Visited by Committee and Staff Members and Examples of Questions Asked in These Site Visits	17
APPENDIX C	Agenda and Participants in Conference on the Changing Role of Doctoral Research Staff in the University	27
APPENDIX D	Sampling Error Estimates for Survey Data Reported in Chapters III and IV	33
APPENDIX E	Characteristics and Employment of Scientists and Engineers Holding Postdoctoral Appointments In Academia in 1977	37
APPENDIX F	Characteristics and Employment of Scientists and Engineers Who Held Academic Appointments in 1977 and Were Not Considered Faculty, Post-doctorals, or Doctoral Research Staff	43
APPENDIX G	Characteristics and Employment of Scientists and Engineers Primarily Engaged in Research in Federally Funded Research and Development Centers in 1977	51

APPENDIX A

COMMITTEE LETTER SENT TO UNIVERSITY DEANS/
DEPARTMENT CHAIRMEN AND LIST OF RECIPIENTS

Letter to Universities

December 16, 1977

Dear

The National Research Council has appointed a committee to study the policy implications of the changing role of postdoctorals and doctoral research staff in higher education and research in the United States. During the last decade, in the face of reduced numbers of faculty openings, there has been a marked increase in the number of younger scholars taking temporary postdoctoral appointments. There also appears to have been an increase in the number of individuals holding nonfaculty research appointments on a continuing basis. We believe that the enlarged role of nonfaculty research appointments in the universities needs to be assessed in the light of perceived benefits and needs.

As a first step in the study, we are writing to a number of people in different institutions and fields who we believe can help us put the situation in perspective. A list of some questions that particularly interest us is enclosed. We would be grateful for your comments on two or three of the questions in this list which you consider to be the most important issues facing the postdoctoral and doctoral research staff at your institution. Our working definitions of "postdoctoral" and of "doctoral research staff" are given on an attached sheet.

We are wary of our own preconception; your views, with those of others, will be important to us in shaping the study. We are especially concerned to identify issues that bear on institutional and national policy or on professional practice. If there are other questions you think we should consider, we would appreciate your suggestions. Please also send us any document your institution may have prepared which bears on the subject. Individual comments will not be identified in the Committee report.

We will greatly appreciate an early reply.

Sincerely yours,

Lee Grodzins, Chairman
Committee on Postdoctorals
and Doctoral Research Staff

The National Research Council is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering to serve government and other organizations

QUESTIONS BEING CONSIDERED BY THE COMMITTEE
ON POSTDOCTORALS AND DOCTORAL RESEARCH STAFF

(1) What is the contribution of postdoctorals and of doctoral research staff, respectively, to the research effort of their host departments and laboratories? What would be the effect of a significant change in their number or quality?

(2) What is the influence of postdoctorals and of doctoral research staff on undergraduate and graduate education?

(3) From the point of view of the individual scholar, has there been any change in the desirability of taking a postdoctoral appointment, of taking a doctoral research staff position? How long should an individual hold these appointments?

(4) Are host institutions giving sufficient attention to their responsibilities towards postdoctorals, towards doctoral research staff? Are new, perhaps more formal, arrangements needed to make the most of their presence--for the benefit of the individuals themselves, their host departments and institutions, or the nation's research effort?

(5) Can a postdoctoral appointment which is supported with research funds serve the scholarly needs of the holder as effectively as an appointment (e.g., a fellowship or traineeship) which is expressly funded to support postdoctoral study? Is there an optimum mix of funding mechanisms?

(6) What view should one take of foreign postdoctorals? Are there too many of them or too few? How many take permanent positions in this country following their postdoctoral work?

(7) Have postdoctoral appointments helped minorities and women to fulfill their promise as research scholars?

(8) Is time spent as a postdoctoral an asset or a liability to a young scientist who will be making his career in industry or a government laboratory?

RECIPIENTS OF LETTER TO UNIVERSITIES

UNIVERSITY OF ARIZONA

Graduate School (Dean)
Department of Chemistry (Chairman)
Department of Optical Sciences (Chairman)
Department of Geosciences (Chairman)
Department of Plant Sciences (Chairman)

BRANDEIS UNIVERSITY

Graduate School (Dean)
Department of Chemistry (Chairman)
Department of Biochemistry (Chairman)
Institute for Photobiology of Cells and Organelles (Chairman)
Department of Sociology (Chairman)

BROWN UNIVERSITY

Graduate School (Dean)
Department of Engineering (Chairman)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Biological and Medical Science (Dean)

UNIVERSITY OF CALIFORNIA - BERKELEY

Graduate School (Dean)
Department of Electrical Engineering and Computer Science (Chairman)
Department of Materials Science and Engineering (Chairman)
Department of Chemistry (Dean)
Department of Physics (Chairman)
Department of Statistics (Chairman)
Department of Physiology and Anatomy (Chairman)
Department of Anthropology (Chairperson)
Department of Sociology (Chairman)

UNIVERSITY OF CALIFORNIA - LOS ANGELES

Graduate School (Dean)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Geology (Chairman)
Department of Geochemistry (Chairman)
Department of Economics (Chairman)
School of Medicine (Dean)
Department of Microbiology and Immunology (Chairman)

UNIVERSITY OF CALIFORNIA - SAN DIEGO

Office of Graduate Studies (Dean)
Department of Chemistry (Chairman)
Department of Biology (Chairman)
Department of Psychology (Chairman)

UNIVERSITY OF CALIFORNIA - SAN FRANCISCO

School of Medicine (Dean)
Department of Biochemistry and Biophysics (Chairman)
Department of Microbiology (Chairman)
Department of Physiology (Chairman)

CALIFORNIA INSTITUTE OF TECHNOLOGY

Graduate School (Dean)
Department of Chemical Engineering (Chairman)
Department of Environmental Engineering Science (Chairman)
Department of Astronomy (Chairman)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Geology (Chairman)
Department of Applied Mathematics (Chairman)

CARNEGIE-MELLON UNIVERSITY

Office of Graduate Studies (Dean)
Department of Chemical Engineering (Chairman)
Department of Physics (Chairman)
Department of Computer Science (Chairman)

UNIVERSITY OF CHICAGO

Graduate School (Dean)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Geophysical Sciences (Chairman)
Department of Biochemistry (Chairman)
Department of Biophysics and Theoretical Biology (Chairman)
Department of Pharmacological and Physiological Sciences (Chairman)
Department of Economics (Chairman)

UNIVERSITY OF COLORADO

Graduate School (Dean)
Department of Physics and Astrophysics (Chairman)
School of Medicine (Dean)
Department of Biophysics and Genetics (Chairman)
Department of Microbiology (Chairman)
Department of Pharmacology (Chairman)

COLORADO STATE UNIVERSITY

Graduate School (Dean)
Department of Chemistry (Chairman)
Department of Range Science (Chairman)
Department of Radiology (Chairman)
Department of Physiology and Biophysics (Chairman)

COLUMBIA UNIVERSITY

Office of Graduate Faculties (Associate Dean)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Geological Sciences (Chairman)
College of Physicians and Surgeons (Dean)
Department of Pathology (Chairman)

CORNELL UNIVERSITY

Graduate School (Dean)
Department of Astronomy

CORNELL UNIVERSITY (continued)

Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Agronomy (Chairman)
Department of Biochemistry (Chairman)

DUKE UNIVERSITY

Graduate School (Vice Provost)
Department of Zoology (Chairman)
Department of Psychology (Chairman)
School of Medicine (Dean)
Department of Physiology and Pharmacology (Chairman)

GEORGETOWN UNIVERSITY

Graduate School (Dean)
Department of Chemistry (Chairman)
School of Medicine (Associate Dean for Academic Affairs)
Department of Physiology (Chairman)

GEORGE WASHINGTON UNIVERSITY

Graduate School (Dean)
Department of Civil and Environmental Engineering (Chairman)
School of Medicine and Health Sciences (Vice President)
Department of Child Health and Development (Chairman)

HARVARD UNIVERSITY

Graduate School (Acting Dean)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Mathematics (Chairman)
Department of Biology (Chairman)
Department of Nutrition (Chairman)
Department of Sociology (Chairman)
School of Medicine (Dean)
Department of Biological Chemistry (Chairman)
Department of Neuropathology (Chairman)

UNIVERSITY OF ILLINOIS - URBANA

Graduate School (Dean)
Department of Civil Engineering (Chairman)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Agronomy (Chairman)

INDIANA UNIVERSITY - BLOOMINGTON

Graduate School (Acting Dean)
Department of Chemistry (Chairman)
Department of Plant Science (Chairman)
Department of Zoology (Chairman)

JOHNS HOPKINS UNIVERSITY

Office of Graduate Studies (Dean)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Biology (Chairman)
Department of Anthropology (Chairman)
Department of Social Relations (Chairman)
School of Medicine (Dean)
Department of Pharmacology and Experimental Therapeutics (Chairman)

UNIVERSITY OF MARYLAND - COLLEGE PARK

Graduate School (Dean)
Department of Physics and Astronomy (Chairman)
Department of Chemistry (Chairman)

UNIVERSITY OF MASSACHUSETTS - AMHERST

Graduate School (Acting Dean)
Department of Polymer Science and Engineering (Chairman)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Computer and Information Science (Chairman)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Graduate School (Dean)
Department of Electrical Engineering and Computer Science (Chairman)
Department of Chemistry (Chairman)
Department of Earth and Planetary Science (Chairman)
Department of Mathematics (Chairman)
Department of Nutrition and Food Science (Chairman)
Department of Psychology (Chairman)
Department of Linguistics (Chairman)

UNIVERSITY OF MICHIGAN

Rackham School of Graduate Studies (Dean)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Medical School (Dean)
Department of Biological Chemistry (Chairman)
Department of Human Genetics (Chairman)

MICHIGAN STATE UNIVERSITY

Graduate School (Dean)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Crop and Soil Science (Chairman)
Department of Biochemistry (Chairman)
Department of Microbiology (Chairman)

UNIVERSITY OF MINNESOTA

Graduate School (Dean)
Department of Mechanical Engineering (Chairman)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Biochemistry (Chairman)
Department of Psychology (Chairman)
Minneapolis Medical School (Dean)
Department of Microbiology (Chairman)

NEW YORK UNIVERSITY

Graduate School (Dean)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Mathematics (Chairman)
School of Medicine (Chairman)
Department of Pathology (Chairman)

UNIVERSITY OF NORTH CAROLINA - CHAPEL HILL

Graduate School (Dean)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Biostatistics (Chairman)

NORTHWESTERN UNIVERSITY

Graduate School (Dean)
Department of Materials Science (Chairman)
Department of Biological Sciences (Chairman)
Department of Psychology (Chairman)

OHIO STATE UNIVERSITY

Graduate School (Dean)
Department of Metallurgical Engineering (Chairman)
Department of Chemistry (Chairman)
Department of Physics (Chairman)

UNIVERSITY OF PITTSBURGH

Graduate School (Dean)
Department of Chemistry (Chairman)
Department of Physics and Astronomy (Chairman)
Department of Computer Science (Chairman)
Department of Life Sciences (Chairman)

PRINCETON UNIVERSITY

Graduate School (Dean)
Department of Aerospace and Mechanical Engineering (Chairman)

PRINCETON UNIVERSITY (continued)

Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Mathematics (Chairman)
Department of Psychology (Chairman)
Department of Economics (Chairman)
Department of Sociology (Chairman)

PURDUE UNIVERSITY

Graduate School (Dean)
Department of Chemical Engineering (Chairman)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Biochemistry (Chairman)
Department of Biological Sciences (Chairman)

RICE UNIVERSITY

Graduate School (Dean)
Department of Chemical Engineering (Chairman)
Department of Chemistry (Chairman)
Department of Space Physics and Astronomy (Chairman)

UNIVERSITY OF ROCHESTER

Office of Graduate Studies (Dean)
Department of Chemistry (Chairman)
Department of Physics and Astronomy (Chairman)
Department of Psychology (Chairman)
School of Medicine (Chairman)
Department of Radiation Biology and Biophysics (Chairman)

ROCKEFELLER UNIVERSITY

Graduate School (Dean)
Department of Cellular Biology (Chairman)
Department of Physiological Psychology (Chairman)
Department of Experimental Psychology (Chairman)

STANFORD UNIVERSITY

Graduate School (Dean)
Department of Electrical Engineering (Chairman)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Computer Science (Chairman)
Department of Biological Sciences (Chairman)
Department of Sociology (Chairman)
School of Medicine (Dean)
Department of Biochemistry (Chairman)
Department of Genetics (Chairman)
Department of Pathology (Chairman)

UNIVERSITY OF SOUTHERN CALIFORNIA

Graduate School (Dean)
Department of Electrical Engineering (Chairman)
Department of Chemistry (Chairman)

SUNY - COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY

Office of Academic Affairs (Dean)
Department of Paper Science and Engineering (Chairman)
Department of Managerial Science and Policy (Chairman)
Department of Chemistry (Chairman)

TEXAS A&M UNIVERSITY

Graduate School (Dean)
Department of Chemistry (Chairman)
Department of Oceanography (Chairman)
Department of Entomology (Chairman)

UNIVERSITY OF TEXAS - AUSTIN

Graduate School (Dean)
Department of Astronomy (Chairman)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Zoology (Chairman)

UNIVERSITY OF UTAH

Graduate School (Dean)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Biology (Chairman)
College of Medicine (Chairman)
Department of Biochemistry (Chairman)

WASHINGTON UNIVERSITY

School of Medicine (Dean)
Department of Anatomy and Neurobiology (Chairman)
Department of Biochemistry (Chairman)
Department of Microbiology and Immunology (Chairman)
Department of Pathology (Chairman)

UNIVERSITY OF WASHINGTON

Graduate School (Dean)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Mathematics (Chairman)
Department of Forest Resources (Chairman)
Department of Zoology (Chairman)
Department of Speech and Hearing Science (Chairman)
School of Medicine (Dean)
Department of Bioengineering (Chairman)
Department of Biochemistry (Chairman)
Department of Genetics (Chairman)

UNIVERSITY OF WISCONSIN - MADISON

Graduate School (Dean)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Meat and Animal Science (Chairman)
Department of Biochemistry (Chairman)
Department of Entomology (Chairman)

UNIVERSITY OF WISCONSIN - MADISON (continued)

Medical School (Dean)
Department of Physiological Chemistry (Chairman)
Laboratory of Genetics (Chairman)

YALE UNIVERSITY

Graduate School (Dean)
Department of Engineering and Applied Science (Chairman)
Department of Chemistry (Chairman)
Department of Physics (Chairman)
Department of Economics (Chairman)
School of Medicine (Dean)
Department of Molecular Biophysics and Biochemistry (Chairman)
Department of Pharmacology (Chairman)

APPENDIX B

LIST OF INSTITUTIONS AND DEPARTMENTS VISITED BY COMMITTEE AND STAFF MEMBERS AND EXAMPLES OF QUESTIONS ASKED IN THESE SITE VISITS

SITE VISITS

STANFORD UNIVERSITY - March 13-14, 1978

Department of Computer Sciences (faculty and graduate students)

Department of Electrical Engineering (one professor, one postdoc, two graduate students)

Department of Sociology (faculty, five postdocs, four graduate students)

UNIVERSITY OF CALIFORNIA, DAVIS - March 9, 1978

Department of Agricultural Engineering (faculty and graduate students)

Graduate Division (Dean)

PURDUE UNIVERSITY - March 2, 1978

School of Chemical Engineering (Chairman and faculty)

School of Chemical Engineering (two graduate students and two postdocs)

Department of Chemistry (professor)

Department of Chemistry (two postdocs and one graduate student)

UNIVERSITY OF WASHINGTON, SEATTLE - February 27-28, 1978

Department of Bioengineering (two research assistant professors, three postdocs, and one graduate student)

College of Forest Resources (Dean and faculty)

College of Forest Resources (two research assistant professors and one research associate)

Medical School (Associate Dean)

Department of Oceanography (faculty)

Department of Oceanography (five postdocs)

Department of Physiology and Biophysics (faculty)

Department of Physiology and Biophysics (four graduate students, three postdocs, and one research assistant professor)

INDIANA UNIVERSITY - February 24, 1978

Department of Biology (Chairman and Associate Chairman)

Department of Biology (five postdocs)

Graduate School (Dean and Associate Dean)

Department of Psychology (faculty)

Department of Psychology (three postdocs and two graduate students)

CHILDREN'S HOSPITAL - January 24, 1978

Child Health and Development Unit (Head)

UNIVERSITY OF MARYLAND - January 23, 1978

Department of Physics (faculty)

Department of Physics (one research associate, one postdoc, and two graduate students)

M.I.T. - January 20, 1978; January 18-19, 1978

Department of Electrical Engineering (faculty)

Department of Nutrition and Food Sciences (faculty)

Department of Nutrition and Food Sciences (two research associates, one D.D.S., and three graduate students)

Provost

Department of Psychology (Chairman, four postdocs)

School of Science (Dean)

HARVARD - January 17-19, 1978

Department of Biology (Chairman and faculty)

Department of Biology (one postdoc, four graduate students)

Department of Mathematics (Chairman)

Department of Mathematics (five Benjamin Pierce Assistant Professors)

Department of Physics (Chairman, faculty, and two postdocs)

School of Public Health (faculty)

School of Public Health (three postdocs and three graduate students)

NATIONAL SCIENCE FOUNDATION - January 13, 1978

Committee on the Role of NSF in Basic Research (Executive Secretary)

NAVAL RESEARCH LABORATORY - January 13, 1978

Chemistry and Physics Sections (faculty)

Chemistry and Physics Sections (fourteen NRC postdocs)

GEORGE WASHINGTON UNIVERSITY - January 10, 1978

Medical School (Vice President for Medical Affairs, Dean for Student Affairs)

NATIONAL SCIENCE FOUNDATION - December 7, 1977; December 2, 1977

Chemistry Research Section (Section Head, six staff members)

Earth Sciences Research Section (Director)

Physics Research Section (Program Director)

EXAMPLES OF QUESTIONS THAT MIGHT BE ASKED OF FACULTY/ADMINISTRATORS

Definitions

(1) What different titles do your postdocs hold? Do their responsibilities differ?

(2) Have any of your postdocs been out of graduate (medical) school longer than three years? longer than six years? What were their previous positions?

(3) What other doctoral research staff do you have that are not considered faculty? Do their responsibilities differ from the postdocs'?

(4) How long are doctoral research staff expected to remain in these positions?

(5) Is there a formal or informal research track parallel to the faculty tenure track?

Contribution to Research

(1) What do you consider a desirable mix of faculty, postdocs, other doctoral staff, and graduate students working on a research project?

(2) Could some of the faculty or graduate students be replaced by postdocs and other doctoral research staff? What effect would this have on the cost and productivity of your research?

(3) What effect would reducing the number of postdocs and other doctoral staff have on your research?

(4) What unique contributions do postdocs and other doctoral staff make to the research project (e.g., training permanent staff in specialized techniques, providing cross-fertilization of ideas among fields or laboratories)?

(5) What fraction of the total intellectual input in a research project does the postdoc provide?

(6) If only the most able half of the postdoctoral group were retained, would it have a significant impact on the department's research productivity?

Contribution to Educational Programs

(1) Should postdocs be given any formal teaching responsibilities? To what extent?

(2) Would it be possible to establish a dual position of postdoc and lecturer? Has this been tried?

(3) What contributions, other than formal teaching, do postdocs and doctoral research staff make to your program of graduate and undergraduate education (e.g., "substitute" teaching, assistance in the lab)?

Training for Research Careers

(1) In recruiting new faculty do you require postdoc experience? How much?

(2) Do you discourage postdocs from remaining in your department more than two or three years? Why?

(3) How frequently have your postdocs or doctoral research staff moved into permanent positions in your department? What is your policy in this regard?

(4) Do you consider it desirable or undesirable for a Ph.D. to continue in the same department for his postdoc appointment? Why?

Institutional/Department Policies

(1) Who has the responsibility for reviewing appointments to postdoctoral positions?

(2) What status does the postdoc hold? What benefits does he/she receive? Is he/she given adequate space, etc.?

(3) Should more formal policies concerning postdoctoral appointments be established by the institution?

Support Mechanisms

(1) Approximately what fraction of the total support for postdocs in your department comes from federal fellowships, training grants, and research grants/contracts? What other sources of support are available?

(2) Which of these mechanisms is most effective in terms of the productivity and cost of research? Which in terms of providing training needs?

(3) What would you consider to be the optimum mix of funding mechanisms?

Foreign Postdocs

(1) What fraction of your postdocs are from foreign countries? How many of these received doctorates from U.S. universities?

(2) What visa status do the foreign postdocs hold? Do they remain in this country after completing their appointments?

(3) How are the foreign postdocs supported? Are they taking positions that might otherwise be held by U.S. citizens?

(4) What unique contributions does the foreign postdoc make?

(5) Should the number of foreign postdocs be increased or reduced?

Women and Minorities

(1) Is the postdoctoral appointment an advantage or a hindrance to a woman or minority scientist planning a research career?

(2) Have you encountered difficulty in recruiting women and minority scientists for postdoctoral appointments? If so, what are the major reasons for this (e.g., age, economic considerations)?

(3) How successful have these groups been in finding permanent positions after the postdoctoral?

Nonacademic Sector

(1) Is postdoctoral training an asset or a liability to the graduate planning a career in research outside the academic sector? Has this situation changed in recent years?

(2) To what extent are postdoctoral appointments in government and industrial labs used to recruit permanent staff? What other unique purposes do these appointments serve (e.g., strengthen the research program)?

(3) What types of positions do postdocs in government and industrial labs take after completing their appointments?

Future of Academic Research

(1) In the face of reduced numbers of faculty openings in the next fifteen years, what possible solutions do you see to maintain the vitality of academic research (e.g., longer-term postdoctoral appointments, visiting assistant professors, incentives for early retirement)?

EXAMPLES OF QUESTIONS THAT MIGHT
BE ASKED OF POSTDOCS/GRADUATE STUDENTS

(1) Did you have a realistic picture of the supply-demand situation in your field before entering graduate school? If not, would this information have influenced your career choice?

(2) What was your primary motivation for taking a postdoctoral appointment? What alternative employment possibilities did you consider? How many had to pay back significant loans for graduate education?

(3) Are you satisfied with your current responsibilities? What improvements, if any, would you make? How much teaching do you do? How much freedom do you have in research? What benefits do you receive? What is your tax status? To what extent are you left out of the mainstream? Is this an advantage or disadvantage?

(4) What are your future career prospects like? To what extent is it possible to convert a postdoctoral appointment into a permanent faculty position in the same department? How do you feel about a career in industry or government? a career in teaching? What process do you use to find a job?

(5) In light of the shortage of tenured positions in academia, would you consider taking a five to ten year appointment? What other solutions to the shortage of permanent academic appointments do you see?

APPENDIX C

AGENDA AND PARTICIPANTS IN CONFERENCE ON THE CHANGING ROLE OF DOCTORAL RESEARCH STAFF IN THE UNIVERSITY

CONFERENCE ON THE CHANGING ROLE OF DOCTORAL RESEARCH STAFF IN THE UNIVERSITY

Joseph Henry Building, Room 200A
21st and Pennsylvania Avenues, N.W.
Washington, D.C.

Friday, September 22, 1978

Agenda

9:00 a.m.	I.	Opening Remarks	Lee Grodzins Dorothy Gilford
9:45 a.m.	II.	Identification of Doctoral Research Staff	Lee Grodzins
		A. Who are doctoral research staff members? (See Attachment A) B. How distinguishable are they from postdoctoral and other nonfaculty staff? (See Attachment B) C. How are their roles different from those of non-Ph.D. staff engaged in research?	
10:45 a.m.	III.	Profile of 1977 Doctoral Research Staff	Porter Coggeshall
		A. In what respects do the demographic characteristics (e.g., age, fraction who are women) and prior training of doctoral research staff differ from those of faculty members? (See Tables 5-8 in Attachment C) B. How do their employment situations differ from those of faculty members? (See Tables 9-14 in Attachment C) C. What fraction of the doctoral research staff are former faculty members who were unsuccessful in acquiring tenure?	
11:30 a.m.	IV.	Contributions to Programs of Research	Lee Grodzins
		A. In what types of research are doctoral research staff members likely to be involved (e.g., applied research, large team efforts)? B. Under what circumstances do they serve as principal investigators? (See Attachment D) C. To what extent is the role in academic research of these staff members changing relative to that of other research personnel (faculty members, postdoctorals, or graduate students)?	
12:15 p.m.		Lunch	

1:15 p.m. V. University Status of Doctoral Research Staff — Bob Weatherall

A. What are the institutional policies concerning the participation of doctoral research staff members in university or laboratory governance?
B. How do the privileges and responsibilities of this group compare to those of faculty and postdoctorals?
C. Should uniform institutional guidelines--formal or otherwise--be established for this group? (See Attachment E)

2:00 p.m. VI. Recent Growth in Nonfaculty Staff — Porter Coggeshall

A. What factors have contributed to the rapid growth in doctoral research staff, postdoctorals, and other nonfaculty groups? (See Attachment F)
B. What are the career prospects for those holding doctoral research staff positions?

3:00 p.m. VII. Implications for the Future — Lee Grodzins

A. What impact will doctoral research staff have on future programs of research?
B. What policy actions should universities and the federal government consider?
C. What are the implications for long-term human resource planning of the development of a nontenure track in academic research?

4:00 p.m. Adjournment

CONFERENCE ON THE CHANGING ROLE OF DOCTORAL

RESEARCH STAFF IN THE UNIVERSITY

Friday, September 22, 1978

Joseph Henry Building
Washington, D.C.

List of Participants

Robert Borchers, Vice Chancellor, University of Colorado

Charles Carter, Office of University Affairs, National Aeronautics and Space Administration

Richard Cunningham, Vice President for Research and Graduate Studies, Pennsylvania State University

Charles Dickens, Division of Science Resources Studies, National Science Foundation

Alan Fechter, Division of Science Resources Studies, National Science Foundation

Wendell Fleming, Department of Mathematics, Brown University

Ronald Geballe, Dean of the Graduate School and Vice Provost for Research, University of Washington

Lee Grodzins (Committee Chairman), Department of Physics, Massachusetts Institute of Technology

Carlos Kruytbosch, Planning and Policy Analysis, National Science Foundation

Lilli Hornig, Executive Director, Higher Education Resource Services, Wellesley College

Shirley Jackson, Bell Laboratories

Richard Meserve, Office of Science and Technology Policy

Charles Miller, National Institute of General Medical Sciences, National Institutes of Health

Michael Pelczar, President, Council of Graduate Schools in the United States

C. J. Pings, Vice Provost, California Institute of Technology

Neena Schwartz, Department of Biological Sciences, Northwestern University

Albert Teich, Graduate Program in Science, Technology, and Public Policy, George Washington University

Robert Van Citters, School of Medicine, University of Washington

Committee Staff

Prudence Brown, Research Associate

Porter Coggeshall, Project Director

Dorothy Gilford, Principal Investigator

Robert Weatherall, Consultant

APPENDIX D

SAMPLING ERROR ESTIMATES FOR SURVEY DATA REPORTED IN CHAPTERS III AND IV

Most of the statistics presented in this report are ratios of two weighted sums of responses to a national survey of Ph.D. recipients. To assist the reader in interpreting the statistics reported in the tables in Chapters III and IV, approximate sampling errors have been calculated. A more comprehensive treatment of sampling errors is given in the 1977 survey report.[34]

The sampling error estimates presented in the table on the following page were computed on the basis of a simple random sample design, using the expression $\left(\frac{p[1-p]}{n}\right)^{\frac{1}{2}}$. The table summarizes sampling errors associated with ranges of percentages reported for various survey groups. For more precise estimates, the reader may use the above expression to calculate sampling errors directly.

[34] National Research Council, Science, Engineering, and Humanities Doctorates in the United States: 1977 Profile (National Academy of Sciences, Washington, D.C., 1978), Appendix E.

APPROXIMATE SAMPLING ERRORS ASSOCIATED WITH VARIOUS PERCENTAGES REPORTED FOR DOCTORAL RESEARCH STAFF AND FACULTY RESEARCH GROUPS IN SCIENCE AND ENGINEERING FIELDS

DOCTORAL RESEARCH STAFF

FIELD OF SCIENCE	APPROX. SAMPLE SIZE*	PERCENTAGE REPORTED 1-10% OR 90-99%	11-20% OR 80-89%	21-30% OR 70-79%	31-40% OR 60-69%	41-59%
TOTAL ALL FIELDS	607	1%	1-2%	2%	2%	2%
MATHEMATICS	30	2-5%	6-7%	7-8%	8-9%	9%
PHYSICS	81	[illegible]-3%	3-4%	5%	5%	5-6%
CHEMISTRY	63	[illegible]-4%	4-5%	5-6%	6%	6%
EARTH SCIENCES	41	2-5%	5-6%	6-7%	7-8%	8%
ENGINEERING	38	2-5%	5-6%	7%	8%	8%
AGRICULTURAL SCIENCES	23	2-6%	7-8%	8-10%	10%	10%
BIOSCIENCES	267	1-2%	2%	2-3%	3%	3%
PSYCHOLOGY	35	2-5%	5-7%	7-8%	8%	8%
SOCIAL SCIENCES	29	2-6%	6-7%	8-9%	9%	9%

FACULTY INVOLVED IN RESEARCH

FIELD OF SCIENCE	APPROX. SAMPLE SIZE*	PERCENTAGE REPORTED 1-10% OR 90-99%	11-20% OR 80-89%	21-30% OR 70-79%	31-40% OR 60-69%	41-59%
TOTAL ALL FIELDS	8382	<1%	<1%	1%	1%	1%
MATHEMATICS	783	<1%	1%	1-2%	2%	2%
PHYSICS	524	<1%	1-2%	2%	2%	2%
CHEMISTRY	657	<1%	1-2%	2%	2%	2%
EARTH SCIENCES	353	1%	2%	2%	2-3%	3%
ENGINEERING	691	<1%	1-2%	2%	2%	2%
AGRICULTURAL SCIENCES	537	<1%	1-2%	2%	2%	2%
BIOSCIENCES	2933	<1%	1%	1%	1%	1%
PSYCHOLOGY	723	<1%	1%	2%	2%	2%
SOCIAL SCIENCES	1181	<1%	1%	1%	1%	1%

*Number of respondents to a particular survey item in a given year may vary somewhat.

APPENDIX E

CHARACTERISTICS AND EMPLOYMENT OF SCIENTISTS AND ENGINEERS HOLDING POSTDOCTORAL APPOINTMENTS IN ACADEMIA IN 1977

(Table numbers are comparable to those presented in Chapter III on doctoral research staff.)

TABLE 5 SEX, COUNTRY OF ORIGIN, AND RACIAL/ETHNIC GROUP OF POSTDOCTORALS, 1977

1977 FIELD OF SCIENCE	SEX				GROUP				
	EST TOTAL N	ITEM RESP n	MALE %	FEML %	EST TOTAL N	ITEM RESP n	US NATIVE BORN WHT %	US NATIVE BORN NONWHT %	FOREIGN BORN %
TOTAL ALL FIELDS	7628	1235	79.3	20.7	7628	1207	76.9	2.1	21.1
MATHEMATICS	82	11	92.7	7.3	82	11	78.0		22.0
PHYSICS	684	103	94.7	5.3	684	101	71.0	1.5	27.5
CHEMISTRY	1226	226	82.1	17.9	1226	221	75.3	2.9	21.8
EARTH SCIENCES	288	40	89.6	10.4	288	38	78.3		21.7
ENGINEERING	353	35	96.6	3.4	353	33	37.2		62.8
AGRICULTURAL SCIENCES	161	23	86.3	13.7	161	23	34.8	1.9	63.4
BIOSCIENCES	4140	720	73.7	26.3	4140	707	80.4	2.4	17.1
PSYCHOLOGY	355	42	75.5	24.5	355	41	94.6	1.4	4.0
SOCIAL SCIENCES	339	35	77.3	22.7	339	32	92.9	.6	6.5

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 6 AGE AND YEAR OF PH.D. OF POSTDOCTORALS, 1977

1977 FIELD OF SCIENCE	AGE					FISCAL YEAR OF PHD				
	EST TOTAL N	ITEM RESP n	UNDER 35 %	35-44 %	45 & OVER %	EST TOTAL N	ITEM RESP n	75-76 %	72-74 %	67-71 %	PRE67 %
TOTAL ALL FIELDS	7628	1233	75.1	22.0	2.9	7628	1235	60.3	26.2	10.0	3.5
MATHEMATICS	82	11	72.0	25.6	2.4	82	11	34.1	48.8	14.6	2.4
PHYSICS	684	103	83.0	16.8	.1	684	103	64.8	24.1	9.8	1.3
CHEMISTRY	1226	225	76.3	21.4	2.3	1226	226	62.6	23.8	7.4	6.1
EARTH SCIENCES	288	40	79.5	19.1	1.4	288	40	73.3	16.0	7.6	3.1
ENGINEERING	353	35	65.2	34.8		353	35	73.7	11.6	11.6	3.1
AGRICULTURAL SCIENCES	161	23	57.1	42.9		161	23	67.1	28.6		4.3
BIOSCIENCES	4140	719	78.5	18.2	3.3	4140	720	59.8	28.2	9.6	2.4
PSYCHOLOGY	355	42	66.5	33.0	.6	355	42	59.2	22.5	13.2	5.1
SOCIAL SCIENCES	339	35	38.3	47.2	14.5	339	35	27.4	36.3	24.8	11.5

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 7 ROOSE-ANDERSEN RATING OF PH.D. GRANTING DEPARTMENT OF POSTDOCTORALS, 1977

1977 FIELD OF SCIENCE	EST TOTAL #	ITEM RESP n	DEPARTMENTAL RATING: DISTINGUISHED %	STRONG %	OTHER RATED %	NOT RATED %
TOTAL ALL FIELDS	7628	1235	14.0	26.0	28.5	31.5
MATHEMATICS	82	11	43.9	28.0	25.6	2.4
PHYSICS	684	103	35.4	28.5	24.7	11.4
CHEMISTRY	1226	226	17.3	22.0	40.5	20.1
EARTH SCIENCES	288	40	13.5	12.5	21.9	52.1
ENGINEERING	353	35	25.5	11.3	12.5	50.7
AGRICULTURAL SCIENCES	161	23		6.8	8.1	85.1
BIOSCIENCES	4140	720	8.3	28.7	26.9	36.1
PSYCHOLOGY	355	42	3.1	37.5	44.8	14.6
SOCIAL SCIENCES	339	35	28.6	25.7	27.4	18.3

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 10 INSTITUTION OF EMPLOYMENT OF POSTDOCTORALS, 1977

1977 FIELD OF SCIENCE	EST TOTAL #	ITEM RESP n	EMPLOYER: TOP 25 R&D UNIV %	NEXT 25 R&D UNIV %	OTHER COLL/ UNIV %
TOTAL ALL FIELDS	7628	1235	46.8	18.7	34.5
MATHEMATICS	82	11	23.2	47.6	29.3
PHYSICS	684	103	45.3	16.7	38.0
CHEMISTRY	1226	226	41.5	15.8	42.7
EARTH SCIENCES	288	40	37.5	17.0	45.5
ENGINEERING	353	35	36.3	16.7	47.0
AGRICULTURAL SCIENCES	161	23	14.9	13.7	71.4
BIOSCIENCES	4140	720	48.4	21.1	30.6
PSYCHOLOGY	355	42	69.9	16.3	13.8
SOCIAL SCIENCES	339	35	65.8	5.6	28.6

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 11 AVERAGE TIME DEVOTED TO RESEARCH AND OTHER WORK ACTIVITIES BY POSTDOCTORALS, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	AVERAGE % TIME IN RSRCH	TEACH	ADMIN	OTHER
TOTAL ALL FIELDS	7628	1192	81.8	3.5	3.0	11.7
MATHEMATICS	82	10	75.3	8.2	1.7	14.8
PHYSICS	684	99	85.2	4.3	3.7	6.8
CHEMISTRY	1226	222	88.5	4.9	1.4	5.2
EARTH SCIENCES	288	39	86.0		3.7	10.3
ENGINEERING	353	33	76.8	7.4	7.3	8.5
AGRICULTURAL SCIENCES	161	22	83.9	3.7	1.3	11.1
BIOSCIENCES	4140	692	83.2	2.4	2.4	12.0
PSYCHOLOGY	355	41	51.8	6.8	7.8	33.6
SOCIAL SCIENCES	339	34	67.4	4.6	4.9	23.1

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 12 MEDIAN STIPEND OF POSTDOCTORALS, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	ALL YEARS	72-76 PHDS	67-71 PHDS	62-66 PHDS	PRE62 PHDS
TOTAL ALL FIELDS	7628	1209	$11,900	$11,600	$13,650	$13,100	$19,450
MATHEMATICS	82	10	*	*	*	*	*
PHYSICS	684	101	12,800	12,800	*	*	*
CHEMISTRY	1226	222	10,450	10,400	10,900	*	*
EARTH SCIENCES	288	40	13,550	13,550	*	*	*
ENGINEERING	353	34	13,450	13,500	*	*	*
AGRICULTURAL SCIENCES	161	22	12,700	11,450	13,550	13,750	*
BIOSCIENCES	4140	708	11,700	11,450	13,550	13,750	*
PSYCHOLOGY	355	40	10,350	10,300	*	*	*
SOCIAL SCIENCES	339	32	15,200	12,050	*	*	*

*Median salaried based on fewer than 15 individuals are not reported.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 13 FEDERAL SOURCES OF SUPPORT FOR POSTDOCTORALS, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	SUPPORTING AGENCY: AC FEDL SUPT %	SOME FEDL SUPT %	DOA %	DOD %	EPA %	ERDA %	NASA %	NIH %	NSF %	OTHERS %
TOTAL ALL FIELDS	7628	1205	17.3	82.7	.9	3.8	1.5	6.9	4.3	51.1	18.4	7.5
MATHEMATICS	82	11	32.9	67.1		23.2		11.0		18.3	14.6	14.6
PHYSICS	684	101	6.3	93.7		8.9		37.8	12.4	3.9	45.2	2.6
CHEMISTRY	1226	221	15.3	84.7	.2	8.6	.4	7.3	1.2	47.8	29.2	1.8
EARTH SCIENCES	288	40	5.9	94.1		6.9	6.3	3.8	35.8	4.5	50.7	14.6
ENGINEERING	353	35	16.7	83.3		14.4		20.4	23.8	18.7	12.5	5.9
AGRICULTURAL SCIENCES	161	22	50.6	49.4	4.4	3.8	5.1			7.0	10.8	24.7
BIOSCIENCES	4140	699	15.0	85.0	1.4	.5	1.9	2.1	.9	73.8	11.7	4.2
PSYCHOLOGY	355	41	30.7	69.3		1.7		.6		36.6	.6	31.0
SOCIAL SCIENCES	339	35	49.6	50.4						2.7	8.6	39.2

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 14 FIELD SWITCHING BY POSTDOCTORALS, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	EMPLOYED IN PHD SPECIALTY FIELD %	EMPLOYED IN PHD BROAD FIELD %	EMPLOYED IN OTHER FIELD %
TOTAL ALL FIELDS	7628	1235	45.1	40.3	14.6
MATHEMATICS	82	11	24.4	37.8	37.8
PHYSICS	684	103	71.8	18.0	10.2
CHEMISTRY	1226	226	44.3	40.3	15.4
EARTH SCIENCES	288	40	49.3	16.0	34.7
ENGINEERING	353	35	72.0	9.1	19.0
AGRICULTURAL SCIENCES	161	23	42.9	55.3	1.9
BIOSCIENCES	4140	720	37.7	48.0	14.3
PSYCHOLOGY	355	42	54.9	40.3	4.8
SOCIAL SCIENCES	339	35	49.9	37.2	13.0

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

APPENDIX F

CHARACTERISTICS AND EMPLOYMENT OF SCIENTISTS AND ENGINEERS WHO HELD ACADEMIC APPOINTMENTS IN 1977 AND WERE NOT CONSIDERED FACULTY, POSTDOCTORALS, OR DOCTORAL RESEARCH STAFF

(Table numbers are comparable to those presented in Chapter III on doctoral research staff.)

TABLE 5 SEX, COUNTRY OF ORIGIN, AND RACIAL/ETHNIC GROUP OF OTHER ACADEMIC STAFF, 1977

1977 FIELD OF SCIENCE	SEX				GROUP				
	EST TOTAL (N)	ITEM RESP (n)	MALE (%)	FEML (%)	EST TOTAL (N)	ITEM RESP (n)	US NATIVE BORN WHT (%)	US NATIVE BORN NONWHT (%)	FOREIGN BORN (%)
TOTAL ALL FIELDS	5394	777	76.3	23.7	5394	746	88.0	1.9	10.1
MATHEMATICS	406	70	83.0	17.0	406	65	84.7	.5	14.8
PHYSICS	311	42	90.7	9.3	311	41	90.6	4.2	5.2
CHEMISTRY	422	78	79.4	20.6	422	74	82.4	5.9	11.8
EARTH SCIENCES	251	37	92.0	8.0	251	33	95.1	.9	4.0
ENGINEERING	468	42	99.4	.6	468	41	79.0		21.0
AGRICULTURAL SCIENCES	325	34	94.5	5.5	325	33	92.8	1.6	5.6
BIOSCIENCES	1304	227	71.9	28.1	1304	221	88.8	.8	10.4
PSYCHOLOGY	961	133	59.9	40.1	961	128	93.6	2.2	4.2
SOCIAL SCIENCES	946	114	68.3	31.7	946	110	85.3	2.4	12.3

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 6 AGE AND YEAR OF PH.D. OF OTHER ACADEMIC STAFF, 1977

1977 FIELD OF SCIENCE	AGE					FISCAL YEAR OF PHD				
	EST TOTAL (N)	ITEM RESP (n)	UNDER 35 (%)	35-44 (%)	45 & OVER (%)	EST TOTAL (N)	ITEM RESP (n)	75-76 (%)	72-74 (%)	67-71 (%)	PRE67 (%)
TOTAL ALL FIELDS	5394	776	23.7	37.6	38.7	5394	777	17.4	20.1	25.8	36.6
MATHEMATICS	406	70	36.2	48.0	15.8	406	70	26.4	18.0	36.0	19.7
PHYSICS	311	42	18.0	37.3	44.7	311	42	7.4	21.2	20.6	50.8
CHEMISTRY	422	78	12.3	39.3	48.3	422	78	6.2	14.7	36.3	42.9
EARTH SCIENCES	251	37	19.9	44.6	35.5	251	37	2.0	21.1	33.5	43.4
ENGINEERING	468	42	16.2	43.8	40.0	468	42	16.2	23.1	19.4	41.2
AGRICULTURAL SCIENCES	325	34	8.0	34.2	57.8	325	34	9.2	22.2	31.1	37.5
BIOSCIENCES	1304	226	27.2	36.1	36.7	1304	227	17.8	21.0	22.4	38.8
PSYCHOLOGY	961	133	31.5	32.9	35.6	961	133	19.0	20.8	30.2	30.0
SOCIAL SCIENCES	946	114	22.7	35.4	41.9	946	114	27.4	18.8	18.0	35.8

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 7 ROOSE-ANDERSEN RATING OF PH.D. GRANTING DEPARTMENT OF OTHER ACADEMIC STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	DEPARTMENTAL RATING: DISTINGUISHED %	STRONG %	OTHER RATED %	NOT RATED %
TOTAL ALL FIELDS	5394	777	13.8	22.4	32.1	31.6
MATHEMATICS	406	70	18.2	32.0	31.0	18.7
PHYSICS	311	42	19.0	24.4	36.7	19.9
CHEMISTRY	422	78	22.5	20.9	38.4	18.2
EARTH SCIENCES	251	37	22.3	19.9	9.2	48.6
ENGINEERING	468	42	9.2	19.0	32.5	39.3
AGRICULTURAL SCIENCES	325	34		6.5	7.1	86.5
BIOSCIENCES	1304	227	8.7	19.9	35.2	36.2
PSYCHOLOGY	961	133	8.0	22.5	40.0	29.1
SOCIAL SCIENCES	946	114	24.1	29.3	30.7	16.0

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 8 PRIOR POSTDOCTORAL TRAINING EXPERIENCE OF OTHER ACADEMIC STAFF WITH 1970-76 PH.D.'S

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	HELD POSTDOC %	NO POSTDOC %
TOTAL ALL FIELDS	2664	230	17.2	82.8
MATHEMATICS	252	34	11.7	88.3
PHYSICS	143	18	31.9	68.1
CHEMISTRY	146	30	42.1	57.9
EARTH SCIENCES	113	16	22.4	77.6
ENGINEERING	232	17	8.6	91.4
AGRICULTURAL SCIENCES	138	10		100.0
BIOSCIENCES	627	76	18.0	82.0
PSYCHOLOGY	486	22	15.8	84.2
SOCIAL SCIENCES	527	7	7.1	92.9

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 9 EMPLOYMENT STATUS OF OTHER ACADEMIC STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL #	ITEM RESP n	FULL TIME %	PART TIME %
TOTAL ALL FIELDS	5394	777	80.7	19.3
MATHEMATICS	406	70	77.1	22.9
PHYSICS	311	42	74.9	25.1
CHEMISTRY	422	78	85.3	14.7
EARTH SCIENCES	251	37	69.3	30.7
ENGINEERING	468	42	85.0	15.0
AGRICULTURAL SCIENCES	325	34	92.9	7.1
BIOSCIENCES	1304	227	81.2	17.8
PSYCHOLOGY	961	133	81.2	18.8
SOCIAL SCIENCES	946	114	76.0	24.0

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 10 INSTITUTION OF EMPLOYMENT OF OTHER ACADEMIC STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL #	ITEM RESP n	EMPLOYER: TOP 25 R&D UNIV %	EMPLOYER: NEXT 25 R&D UNIV %	EMPLOYER: OTHER COLL/ UNIV %
TOTAL ALL FIELDS	5394	777	20.4	9.8	69.9
MATHEMATICS	406	70	17.2	11.1	71.7
PHYSICS	311	42	21.5	7.1	71.4
CHEMISTRY	422	78	15.4	10.2	74.4
EARTH SCIENCES	251	37	18.7	4.4	76.9
ENGINEERING	468	42	31.4	17.5	51.1
AGRICULTURAL SCIENCES	325	34	39.4	11.1	49.5
BIOSCIENCES	1304	227	24.5	11.7	63.8
PSYCHOLOGY	961	133	13.9	7.6	78.5
SOCIAL SCIENCES	946	114	12.8	6.7	80.5

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 11 AVERAGE TIME DEVOTED TO RESEARCH AND OTHER WORK ACTIVITIES BY OTHER ACADEMIC STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	AVERAGE % TIME IN RSRCH	TEACH	ADMIN	OTHER
TOTAL ALL FIELDS	5394	680	11.0	36.3	21.0	31.7
MATHEMATICS	406	63	13.8	50.1	20.5	15.6
PHYSICS	311	37	18.7	37.0	28.4	15.9
CHEMISTRY	422	68	6.7	55.8	20.0	17.5
EARTH SCIENCES	251	29	21.7	33.0	29.5	15.8
ENGINEERING	468	41	17.7	24.9	32.2	25.2
AGRICULTURAL SCIENCES	325	29	9.3	23.5	25.7	41.5
BIOSCIENCES	1304	196	11.6	32.5	19.0	36.9
PSYCHOLOGY	961	124	5.8	25.2	15.7	53.3
SOCIAL SCIENCES	946	93	8.0	50.8	17.8	23.4

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 12 MEDIAN SALARY OF OTHER ACADEMIC STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	ALL YEARS	72-76 PHDS	67-71 PHDS	62-66 PHDS	PRE62 PHDS
TOTAL ALL FIELDS	4351	477	$19,700	$17,500	$20,700	$25,050	$26,250
MATHEMATICS	313	43	18,150	15,200	20,100	*	*
PHYSICS	233	22	21,150	*	*	*	*
CHEMISTRY	360	44	18,300	16,000	*	*	*
EARTH SCIENCES	174	24	20,150	*	*	*	*
ENGINEERING	398	29	24,400	*	*	*	*
AGRICULTURAL SCIENCES	302	28	23,350	*	*	*	*
BIOSCIENCES	1072	135	19,300	17,450	17,400	26,200	25,150
PSYCHOLOGY	780	88	19,600	17,600	19,750	22,450	*
SOCIAL SCIENCES	719	64	18,350	17,250	*	*	*

*Median salaries based on fewer than 15 individuals are not reported.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 13 FEDERAL SOURCES OF SUPPORT FOR OTHER ACADEMIC STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL	ITEM RESP	NO FEDL SUPT	SOME FEDL SUPT	SUPPORTING AGENCY: DOA	DOD	EPA	ERDA	NASA	NIH	NSF	OTHERS
	N	N	%	%	%	%	%	%	%	%	%	%
TOTAL ALL FIELDS	5394	690	66.9	33.1	4.9	3.8	2.6	4.4	1.8	7.9	5.1	10.8
MATHEMATICS	406	66	81.9	18.1		.3				9.0	6.5	2.3
PHYSICS	311	38	60.2	39.8		2.1		18.7	11.4	.7	6.6	2.4
CHEMISTRY	422	68	80.3	19.7		3.3	2.4	2.7	3.3	11.0	1.2	8.1
EARTH SCIENCES	251	34	59.1	40.9	3.9	7.3	13.8	2.6			24.6	23.3
ENGINEERING	468	39	39.4	60.6	2.5	16.5	3.0	19.3	7.3	5.0	13.3	8.0
AGRICULTURAL SCIENCES	325	30	39.9	60.1	51.2	3.4					3.8	5.8
BIOSCIENCES	1304	191	63.3	36.7	4.4	1.6	5.8	3.4		15.0	2.6	16.8
PSYCHOLOGY	961	124	76.2	23.8		4.3			.6	9.0	4.0	8.2
SOCIAL SCIENCES	946	100	77.9	22.1	1.8	1.0	.7	2.4	.7	4.3	.7	13.3

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 14 FIELD SWITCHING BY OTHER ACADEMIC STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL	ITEM RESP	EMPLOYED IN: PHC SPECIALTY FIELD	PHC BROAD FIELD	OTHER FIELD
	N	N	%	%	%
TOTAL ALL FIELDS	5394	777	31.4	38.2	30.4
MATHEMATICS	406	70	17.5	49.0	33.5
PHYSICS	311	42	30.9	51.4	17.7
CHEMISTRY	422	78	19.2	43.4	37.4
EARTH SCIENCES	251	37	19.5	29.9	50.6
ENGINEERING	468	42	41.7	27.1	31.2
AGRICULTURAL SCIENCES	325	34	52.3	33.5	14.2
BIOSCIENCES	1304	227	24.4	44.6	31.0
PSYCHOLOGY	961	133	38.5	36.7	24.8
SOCIAL SCIENCES	946	114	36.6	28.5	34.9

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

APPENDIX G

CHARACTERISTICS AND EMPLOYMENT OF SCIENTISTS AND ENGINEERS PRIMARILY ENGAGED IN RESEARCH IN FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS IN 1977

(Table numbers are comparable to those presented in Chapter III on doctoral research staff.)

TABLE 5 SEX, COUNTRY OF ORIGIN, AND RACIAL/ETHNIC GROUP OF FFRDC RESEARCH STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	SEX MALE %	SEX FEML %	EST TOTAL N	ITEM RESP n	GROUP US NATIVE BORN WHT %	GROUP US NATIVE BORN NONWHT %	GROUP FOREIGN BORN %
TOTAL ALL FIELDS	5166	585	96.7	3.3	5166	563	82.9	1.6	15.4
MATHEMATICS	336	38	98.2	1.8	336	38	88.7		11.3
PHYSICS	1800	216	97.6	2.4	1800	207	82.4	2.0	15.5
CHEMISTRY	635	72	95.1	4.9	635	71	93.5	.6	5.9
EARTH SCIENCES	282	31	98.2	1.8	282	31	86.5		13.5
ENGINEERING	1541	147	98.8	1.2	1541	139	77.9	1.9	20.2
AGRICULTURAL SCIENCES	*	*							
BIOSCIENCES	433	67	87.8	12.2	433	63	77.2	3.4	19.4
PSYCHOLOGY	*	*							
SOCIAL SCIENCES	101	11	89.1	10.9	101	11	88.1		11.9

*Too few cases for percentages to be reported.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 6 AGE AND YEAR OF PH.D. OF FFRDC RESEARCH STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	AGE UNDER 35 %	AGE 35-44 %	AGE 45 & OVER %	EST TOTAL N	ITEM RESP n	FISCAL YEAR OF PHD 75-76 %	FISCAL YEAR OF PHD 72-74 %	FISCAL YEAR OF PHD 67-71 %	FISCAL YEAR OF PHD PRE67 %
TOTAL ALL FIELDS	5166	585	32.6	42.5	24.9	5166	585	14.1	23.4	28.1	34.4
MATHEMATICS	336	38	20.8	57.1	22.0	336	38	1.5	20.8	39.9	37.8
PHYSICS	1800	216	37.9	35.6	26.4	1800	216	12.8	21.2	26.3	39.7
CHEMISTRY	635	72	39.4	24.1	36.5	635	72	18.1	20.0	14.8	47.1
EARTH SCIENCES	282	31	16.5	59.2	21.3	282	31	8.2	27.0	40.4	24.5
ENGINEERING	1541	147	28.3	50.8	20.9	1541	147	13.9	26.3	32.5	27.3
AGRICULTURAL SCIENCES	*	*									
BIOSCIENCES	433	67	39.0	37.2	23.8	433	67	29.1	25.4	17.6	27.7
PSYCHOLOGY	*	*									
SOCIAL SCIENCES	101	11	19.8	67.3	12.9	101	11	14.9	15.8	47.5	21.8

*Too few cases for percentages to be reported.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 7 ROOSE-ANDERSEN RATING OF PH.D. GRANTING DEPARTMENT OF FFRDC RESEARCH STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	DEPARTMENTAL RATING: DISTINGUISHED %	STRONG %	OTHER RATED %	NOT RATED %
TOTAL ALL FIELDS	5166	585	28.5	24.9	26.9	19.7
MATHEMATICS	336	38	32.4	24.7	28.6	14.3
PHYSICS	1800	216	31.8	27.5	33.9	6.3
CHEMISTRY	635	72	43.3	31.2	21.3	4.6
EARTH SCIENCES	282	31	34.0	16.7	17.0	32.3
ENGINEERING	1541	147	20.0	21.9	24.6	33.5
AGRICULTURAL SCIENCES	*	*				
BIOSCIENCES	433	67	11.1	21.7	18.2	49.0
PSYCHOLOGY	*	*				
SOCIAL SCIENCES	101	11	63.4	21.8	5.9	8.9

*Too few cases for percentages to be reported.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 8 PRIOR POSTDOCTORAL TRAINING EXPERIENCE OF FFRDC RESEARCH STAFF WITH 1970-76 PH.D.'S

1977 FIELD OF SCIENCE		EST TOTAL N	ITEM RESP n	HELD POSTDOC %	NO POSTDOC %
TOTAL ALL FIELDS	H	2637	276	51.0	49.0
MATHEMATICS	H	137	13	22.6	77.4
PHYSICS	H	871	101	65.6	34.4
CHEMISTRY	H	289	33	87.5	12.5
EARTH SCIENCES	H	165	17	62.5	37.5
ENGINEERING	H	806	70	22.3	77.7
AGRICULTURAL SCIENCES	H	*	*		
BIOSCIENCES	H	277	38	68.0	32.0
PSYCHOLOGY	H	*	*		
SOCIAL SCIENCES	H				

*Too few cases for percentages to be reported.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 9 EMPLOYMENT STATUS OF FFRDC RESEARCH STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	FULL TIME %	PART TIME %
TOTAL ALL FIELDS	5166	538	99.5	.5
MATHEMATICS	336	38	100.0	
PHYSICS	1800	194	99.8	.2
CHEMISTRY	635	61	98.9	1.1
EARTH SCIENCES	282	30	100.0	
ENGINEERING	1541	144	99.9	.1
AGRICULTURAL SCIENCES	*	*		
BIOSCIENCES	433	57	98.4	1.6
PSYCHOLOGY	*	*		
SOCIAL SCIENCES	101	11	94.1	5.9

*Too few cases for percentages to be reported.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 11 AVERAGE TIME DEVOTED TO RESEARCH AND OTHER WORK ACTIVITIES BY FFRDC RESEARCH STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	AVERAGE % TIME IN RSRCH	TEACH	ADMIN	OTHER
TOTAL ALL FIELDS	5166	568	83.7	.6	7.2	8.5
MATHEMATICS	336	36	80.4	1.0	5.6	13.0
PHYSICS	1800	208	85.8	.6	6.8	6.8
CHEMISTRY	635	70	89.4	.5	3.6	6.5
EARTH SCIENCES	282	29	71.8		14.4	13.8
ENGINEERING	1541	144	82.6	.5	7.6	9.3
AGRICULTURAL SCIENCES	*	*				
BIOSCIENCES	433	67	84.9	.7	7.0	7.4
PSYCHOLOGY	*	*				
SOCIAL SCIENCES	101	11	64.4	.9	15.4	19.3

* Too few cases for percentages to be reported.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 12 MEDIAN SALARY OF FFRDC RESEARCH STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	ALL YEARS	72-76 PHDS	67-71 PHDS	62-66 PHDS	PRE62 PHDS
TOTAL ALL FIELDS	5142	556	$26,750	$22,700	$27,200	$29,300	$31,500
MATHEMATICS	336	36	28,100	*	*	*	*
PHYSICS	1796	205	26,800	21,150	26,200	29,200	31,400
CHEMISTRY	629	68	26,150	19,900	*	*	31,200
EARTH SCIENCES	282	29	26,200	*	*	*	*
ENGINEERING	1539	140	27,250	24,400	28,300	29,650	31,950
AGRICULTURAL SCIENCES			*	*	*	*	*
BIOSCIENCES	427	65	22,700	18,400	*	*	*
PSYCHOLOGY			*	*	*	*	*
SOCIAL SCIENCES	95	10	*	*	*	*	*

*Median salaries based on fewer than 15 individuals are not reported.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 13 FEDERAL SOURCES OF SUPPORT FOR FFRDC RESEARCH STAFF, 1977

			SUPPORTING AGENCY									
1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	AE FEDL SUPT %	SOME FEDL SUPT %	DOA %	DOD %	EPA %	ERDA %	NASA %	NIH %	NSF %	OTHERS %
TOTAL ALL FIELDS	5144	582	.8	99.2	1.0	13.4	2.3	75.1	6.3	3.8	6.1	12.8
MATHEMATICS	336	38		100.0		34.2		49.8	14.9	3.6	6.8	19.3
PHYSICS	1800	216		100.0		12.6		82.2	6.2	1.1	8.5	2.6
CHEMISTRY	635	72	3.8	96.2		11.5	2.8	89.3	.5	5.5		12.4
EARTH SCIENCES	282	31	3.9	96.1		8.2	20.6	56.4	18.4		30.5	10.6
ENGINEERING	1541	146		100.0	1.0	15.5	.8	70.9	6.9	.8	.8	19.0
AGRICULTURAL SCIENCES	*	*										
BIOSCIENCES	433	66	1.4	98.6	1.8		5.3	87.9	.2	26.5	.7	18.6
PSYCHOLOGY	*	*										
SOCIAL SCIENCES	101	10		100.0		17.8	10.0	32.2			42.2	73.3

*Too few cases for percentages to be reported.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.

TABLE 14 FIELD SWITCHING BY FFRDC RESEARCH STAFF, 1977

1977 FIELD OF SCIENCE	EST TOTAL N	ITEM RESP n	EMPLOYED IN PRC SPECIALTY FIELD %	EMPLOYED IN PRC BROAD FIELD %	EMPLOYED IN OTHER FIELD %
TOTAL ALL FIELDS	5166	585	41.1	35.8	23.1
MATHEMATICS	336	38	16.1	31.5	52.4
PHYSICS	1800	216	47.8	39.4	12.7
CHEMISTRY	635	72	51.2	41.6	7.2
EARTH SCIENCES	282	31	11.7	22.C	66.3
ENGINEERING	1541	147	42.4	31.1	26.5
AGRICULTURAL SCIENCES	*	*			
BIOSCIENCES	433	67	35.1	47.8	17.1
PSYCHOLOGY	*	*			
SOCIAL SCIENCES	101	11	34.7	13.9	51.5

*Too few cases for percentages to be reported.

SOURCE: NRC, Survey of Doctorate Recipients, 1977.